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MYCOTYPHA MICROSPORA, A NEW GENUS OF THE MUCORACEAE

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(WITH PLATES 2 AND 3 AND 1 TEXT FIGURE)

INTRODUCTION

The fungus described in this paper was found growing as a contamination on a plate culture of a pathogenic organism of the orange. Because of the unknown source of the fungus it has been necessary for the writer to limit her observations to its growth and development on artificial media and while perhaps of no interest as a pathological problem, the unusual nature of the fungus and its many variations make it an interesting object for study from the standpoint of mycology.

After making a thorough study of this fungus and searching the literature for an organism either identical with or similar to it, the writer has come to the conclusion that it represents a new genus of the Mucoraceae, belonging to the tribe Cephalideae, according to the classification followed by Gaümann and Dodge (**9**). This group includes *Choanephora*, *Cunninghamella*, *Blakeslea*, *Syncephalastrum*, *Syncephalis* and *Piptocephalis*, genera which are characterized by the conidial fructifications rather than the sporangial type; however, the latter are sometimes present also. Although it is customary to place a fungus with the Fungi Imperfecti until the perfect stage has been found, certain characteristics of the fungus under discussion show such a marked resemblance to the genera of the Mucoraceae, that the writer feels justified in placing it in this family. Notwithstanding the fact that zygospores have never been observed, an effort has been

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made in this paper to point out certain characteristics which are common to members of the Cephalideae and to the fungus herein described.

DESCRIPTION OF THE FUNGUS

One of the characters common to genera of the Cephalideae and to the fungus under consideration is the nature of the thallus. The vegetative hyphae spread over the surface of the substratum forming a thallus that resembles those found among species of the Mucoraceae. It is much branched, contains a dense granular protoplasm and frequently many vacuoles. There is a lack of uniformity in the diameter of the mycelium (PLATE 3, FIG. E) and at times the main tubes are swollen and constricted, generally where the secondary branches are attached. These large trunks give rise to numerous small branches that usually extend nearly parallel to the main hyphae. There is a marked difference in diameter at the tips of the hyphal branches which are finely attenuate as compared with that at their origin (FIG. 1). The contents of the tips of these hyphae appear to be more homogeneous than the dense granular protoplasm of the main trunks. The thallus is coenocytic during the period of growth but septation occurs at maturity about coincident with the time of sporulation. The septa are irregularly disposed, frequently occurring in close proximity to the origin of a branch or often separating the younger growth from the older vacuolated portions.

The fructifications originate as long slender filaments arising from the vegetative hyphae. The extremities of these filaments are at first filled with a homogeneous protoplasm that becomes coarsely granular and assumes a reticulate appearance. These filaments become dilated to form capitella (PLATE 2, FIG. A), the shape of which is suggestive of miniature cat-tails (PLATE 2, FIGS. C AND D). The sterigmata appear as slight swellings on the capitellum from which conidia bud (PLATE 2, FIG. B), and enlarge until they entirely cover the hollow cylindrical head. The tiny sterigmata appear to be arranged in a flat right hand spiral around the capitellum, although other more prominent spirals of a very high pitch may also be traced both clockwise and counterclockwise. The sterigmata on the flat primary spiral

are so spaced that those of one coil alternate with the ones on the coil above and below it. On a naked collapsed head from which the spores have abscised, the sterigmata appear to be arranged in diagonal rows as illustrated in (PLATE 2, FIG. F). The fertile heads usually appear from 24 to 48 hours after the spores

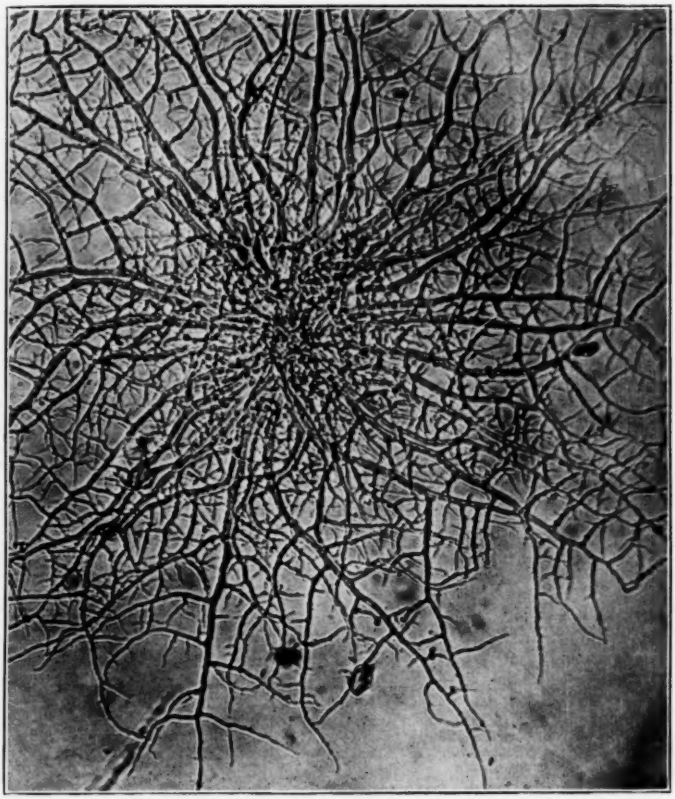

FIG. 1. A thallus of the fungus, *Mycotypha microspora* showing the main trunks and the finely attenuate tips (× 130).

are sown, the length of time depending on the temperature, moisture and nature of the substratum. Tiny water drops are formed during the growing period and adhere to the aerial mycelium for several days after the heads are formed. The obser-

vations regarding color were made when the fungus was grown on Leonian's agar, potato dextrose, and other rich media but the color varies somewhat, depending on the nature of the substratum. The fructifications are at first white, sometimes showing a pinkish iridescence. They become darker at maturity gradually changing from a pale violet gray to a dusky slate gray (**14**). In extreme old age the colonies become a deep brown color. The fructifications grow compactly together (PLATE 3, FIG. A), and although not rigid they generally stand erect. As the fungus is extremely heliotropic, the conidiophores tend to incline toward the source of the illumination (PLATE 3, FIG. C).

The capitella vary in length from 20 μ to over 500 μ but the majority measure about 200 to 300 $\mu \times 17$ to 20 μ with the spores removed. The very small heads may be considered more of an aborted form resulting from a deficient medium. The conidiophores, frequently bearing lateral branches, are several times as long as the cylindrical heads. They are non-septate in a fresh culture but usually 3 to 4 days after germination numerous septa are formed at intervals of 8 to 10 μ or even less (PLATE 2, FIG. H). This septation is characteristic of *Thamnocephalis* (**1**) and its near relatives. The conidiophores at first are hyaline but become yellowish with age.

The conidia are caducous at maturity leaving the hollow cylindrical head exposed. Under low power the naked capitellum appears to be marked with many areolations or orifices but proper focusing after the spores have fallen off reveals numerous protuberances bearing scars where the sterigmata were attached (PLATE 2, FIG. E). In shape, the conidia vary from ovoid to spherical and range in color from hyaline to a pale bluish-green. The sterigmata generally adhere to the conidia as small hyaline beak-like appendages after the conidia have dropped from the head. Under high power either a nucleus or a vacuole is visible but the spores are so minute that no definite statement can be made in this regard. No outer wall is present so far as the writer can ascertain, although some authors have disagreed on this point in reference to other similar conidia-bearing fungi, Van Tieghem (**17**) and others contending that the structures borne on the heads are one-spored sporangia rather than true conidia.

The spores vary from 2 to 4 μ in diameter and average about 2.5 μ. The possible error resulting from the minuteness of the spores and their motion in the mounting fluid was compensated for by the fact that all measurements were made under the same conditions. Germination takes place on culture media a few hours after the conidia are sown, the length of the period depending on the conditions of temperature, moisture and nutrition. They do not germinate in water. The conidia enlarge considerably before germination, and although one or two germ tubes may be formed, one has been observed in most instances.

VARIABILITY

Like many other members of the Mucoraceae, the fungus under consideration shows interesting variations in culture. The organism has been grown on a large variety of artificial media but the description and measurements given in this paper are confined to the monosporous cultures grown on Leonian's agar, as experience with various other fungi has shown that their growth and development may be regarded as normal on this substratum. The organism grows rapidly and luxuriantly on rich nutrient media such as potato dextrose and carrot agars, but practically no growth occurs on media of a low pH value. The fungus behaves in an interesting manner when grown on potato dextrose or carrot agar, particularly during the summer months or at a high artificial temperature. The growth is unusually luxuriant at a temperature of 35° C., whereas practically no growth results when cultures are kept at a temperature of about 10° C. When grown under very favorable conditions, secondary heads are sometimes formed directly on the capitellum (PLATE 2, FIG. G) not unlike the ramuli which develop on the capitate vescicle of *Choanephora cucurbitarum* (**4**). Secondary heads have also been observed by the writer in *Cunninghamella*. Frequently these secondary fructifications are exact miniatures of the large primary head but in most instances they are nearly spherical. When spores from one of these tiny heads are sown, normal individuals are produced. The spherical type of head has also been observed when a weak medium is used as the substratum or in an old culture after the nutritive elements have been exhausted.

There are many gradations in size and shape between the large cylindrical and the small spherical type of fructifications.

Self penetration or "Durchwachsungen" is one of the modifications noted when the fungus is grown on a rich medium and at a high temperature (PLATE 3, FIG. D). Certain vegetative hyphae enter those devoid of protoplasm and take the place of dead portions of the hyphae. This condition has been mentioned frequently in the literature. Duggar and Stewart (**8**) reported self penetration in *Rhizoctonia*, Dodge (**7**) has observed it in *Ascobolus magnificus* and many others have referred to its occurrence in various fungi.

One of the peculiarities of this fungus is the typical development of its fructifications at night. According to Cunningham (**4**) *Choanephora* behaves in a similar manner. Möller (**12**) and Palm and Jochems (**13**) have also observed that *Choanephora* forms its fertile heads in darkness or in the early hours of the morning. The writer has found it impossible to study spore formation during the daytime when the fungus is grown under normal conditions of light and dark. However, when the rhythm is interrupted, heads in various stages of development may be observed. This was done by subjecting plate cultures of the organism to artificial light during the night for several weeks. Other plates were kept in constant darkness for the same period of time. Both sets of cultures produced fertile heads, those in the light seeming to be more perfectly developed even than those in the dark. Since there was a possibility that diurnal changes in temperature rather than the alternation of light and dark might influence spore formation, the normal changes of temperature were duplicated as nearly as possible in the laboratory, and observations made in reference to the development of the aerial filaments. In this experiment little if any significance could be attached to temperature changes as contributing factors in spore formation.

The organism's response to light has been previously mentioned. When a Petri dish culture is turned away from the source of the illumination, the aerial filaments turn back again after a period of time varying from a few hours to 48 hours. If the culture remains for a long time in one position in reference to the source

of light, concentric zones of growth (PLATE 3, FIG. B) are formed, probably resulting from the periodic dropping of spores during the day. Plate cultures of the fungus which were kept in complete darkness for several weeks show that the conidia are not deciduous under these conditions. Weimer (**19**) reports the influence of light upon the direction in which the spores of *Pleurage* are discharged.

SPHERICAL BODIES

Under certain conditions the fungus produces interesting spherical bodies, the average size being about 20 μ in diameter. Although considerable study has been made of these bodies, their true nature can not be wholly explained and the writer can only offer an opinion as to their origin and function, based on the facts here recorded. These spherical structures are easily overlooked as they are usually formed below the surface of the substratum. They were first observed in an old culture and at that time they were thought to be the result of degeneration. Further study has shown, however, that they develop when the culture is comparatively young and have been observed clustered near the center of a young thallus before the fructifications are formed. They have been found in great abundance on Leonian's agar, and a medium which is semi-liquid or one that contains a large amount of sugar seems to encourage their development. So far as the writer can ascertain, spherical structures containing a dense vacuolate protoplasm are usually formed apically on the hyphae. These bodies closely resemble the azygospores frequently found in one strain of a heterothallic fungus in the absence of the other strain. Occasionally one of these bodies will be noticed with a club-like structure attached (PLATE 3, FIG. G), not unlike the oogonium with the accompanying antheridium characteristic of the *Saprolegnia*. Further study of these spherical structures revealed a number of similar bodies with translucent watery contents and thin outer membrane, clustered around and appearing to cling to the primary organ (PLATE 3, FIG. E). These are suggestive of a group of adherent bubbles with no apparent means of attachment, the secondary spheres breaking away from the mother sphere after a time. Observations indicate that a process of budding takes place similar to that occurring in yeast

and many other fungi. Gäumann and Dodge (**9**) report that in certain families of the Zygomycetes the mycelium sometimes breaks up into oidia and hyphal bodies from which sprout cells later develop. Heald (**10**) mentions that under abnormal conditions the hyphae of some of the Zygomycetes divide into cells similar to yeast cells in their behavior. In at least some of these spherical bodies, a differentiation of protoplasm occurs forming a spherical endogenous body with a thick outer wall. These bodies have been observed in the act of breaking away from the encompassing wall (PLATE 3, FIG. F) and frequently have been seen to germinate. These structures have somewhat the appearance of the monosporangium type of fructification found in certain species of Mucoraceae and behave in much the same manner as the sporangiospore when it leaves the monosporangium. Other bodies which are frequently arranged in chains have been found in dried plate cultures and considered as true chlamydospores.

TAXONOMIC DISCUSSION

This fungus is one of the few interesting fungi that has affinities with both the Hyphomycetes and the Mucorales and it is difficult to assign it to its exact taxonomic position. In the absence of zygospores the writer considered placing the fungus under discussion among the Hyphomycetes in the neighborhood of *Rhopalomyces* and *Oedocephalum*, particularly the latter, one species of which Vuillemin (**18**) proved to be connected with *Aleuria asterigma*, of the *Peziza* group. Thaxter (**15**) has reported finding several species of small *Peziza* in cultures of *Oedocephalum* which strengthens Vuillemin's hypothesis of a connection between these fungi. Brefeld (**3**) also established a relationship between one of the Basidiomycetes, *Polyporus annosus* and an *Oedocephalum*-like fungus. *Cunninghamella echinulata* was first described by Thaxter (**16**) under the name of *Oedocephalum echinulata* and the same author, in his study of *Choanephora cucurbitarum*, found it had previously been described under the name of *Rhopalomyces cucurbitarum* Berk. & Rav., a near relative of *Odeocephalum*. Boedijn (**2**) also claims that *Rhopalomyces elegans* Corda is a true Zygomycete regardless of the absence of the sexual stage.

Cunningham (**5**) and others maintain that the type of fructi-

fication depends on nutrition and environmental factors. With this in mind numerous fruitless attempts have been made to produce zygospores in culture by growing the fungus on a large variety of substrata and under various conditions of temperature, moisture and light. The behavior of the organism at times leads the writer to believe that the fungus represents one strain of a heterothallic species. When grown on beef agar the twisting of certain mycelial filaments resembles to a marked degree the manner of coiling found in the copulation branches of some species of the Mucoraceae, such as *Syncephalis*, during the process of zygospore formation.

Both Wolf (**20**) and Dastur (**6**) have pointed out in the case of *Choanephora*, that zygospores are produced in artificial cultures only when the cultures are made directly from the fungus growing on the host plant. In view of the apparent affinity between *Choanephora* and the fungus under consideration, it is possible that the latter possesses this same characteristic.

As a result of experimentation with several hundred different fungi as hosts, Matruchot (**11**) concluded that spores of *Piptocephalis* will germinate only in the presence of some species of the Mucoraceae. It was as a result of these experiments that he claimed that *Choanephora* and *Cunninghamella* belong to this group. The writer has tried this experiment using the fungus herein described as host. When grown with the latter on plates of cornmeal agar, the spores of *Piptocephalis* germinate and the hyphae of *Piptocephalis* appear to be attached to those of the host and to coil around them. If Matruchot is correct in his deductions, one would be justified in believing the fungus described here to be a member of the Mucoraceae. Regardless of any taxonomic value, however, this proves an interesting experiment.

From all the information gained in the study of the fungus described in this paper, the writer has come to the conclusion that it belongs in the tribe Cephalideae of the Mucoraceae, because of the Mucoraceous type of thallus, its coenocytic nature and a number of other attributes which are characteristic of this group of fungi.

The name *Mycotypha microspora* is suggested for the fungus

because of the cat-tail-like fructifications and the extremely minute spores.

The writer wishes to express her indebtedness to Dr. C. H. Kauffman, Dr. H. M. Fitzpatrick, Dr. Roland Thaxter and others for examining the fungus and for helpful suggestions, and to Miss Vera K. Charles, Associate Pathologist, Bureau of Plant Industry, for carefully reading and criticizing the manuscript.

Mycotypha gen. nov.

Hyphae steriles primo continuae, in aetate septatae. Hyphae fertiles plerumque erectae, conidiophoris longis gracilibus capitella fertilia ferentibus. Conidiophora interdum ramosa, primo continua, deinde multiseptata. Capitella cylindrica, conidia solitaria communiter in brevis sterigmatibus ferentia.

Mycotypha microspora sp. nov.

Mycelium sterile praecipiis truncis hyalinis, dense granulosum, irregulariter ramosum, apicibus minute attenuatis, primo continuis, in maturitate septatis. Hyphae fertiles gregariae, fere erectae, seu plerumque semiprostratae. Conidiophora longa, gracilia, primo continua, deinde septata, in culturis juvenilibus hyalina, in aetate luteola-fusca. Capitella cylindrica, in longitudine variabilia, sine conidiis plus minusve 200–300 $\mu \times$ 17–20 μ, condidiis primo albis, deinde obscuris cineriis-subcaeruliis, sterigmatibus in spira plana institutis, unae spirae aliis supra et infra alternantibus, in seriebus diagonalibus in vescicula nuda collapsa, minutis, inconspicuis, saepe ad conidia adhaerescentibus. Conidia multa, minuta, caduca, hyalina-viridicaerulescentia, ovoidea-globosa, 2–4 μ diam. plerumque 2.5 μ.

Pseudogemmae plerumque praesentes, in agaro submersae, in medio semi-liquido seu saccharino magis copiosae, gemmiparae et ab cellula primaria derumpentes, primo translucidae, plerumque chlamydosporas simulantes.

Pseudogemmae sometimes present, submerged in agar, occurring more abundantly on semi-liquid or saccharine media, budding and breaking away from primary cell, translucent at first, sometimes appearing to function as resting spores.

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EXPLANATION OF PLATES

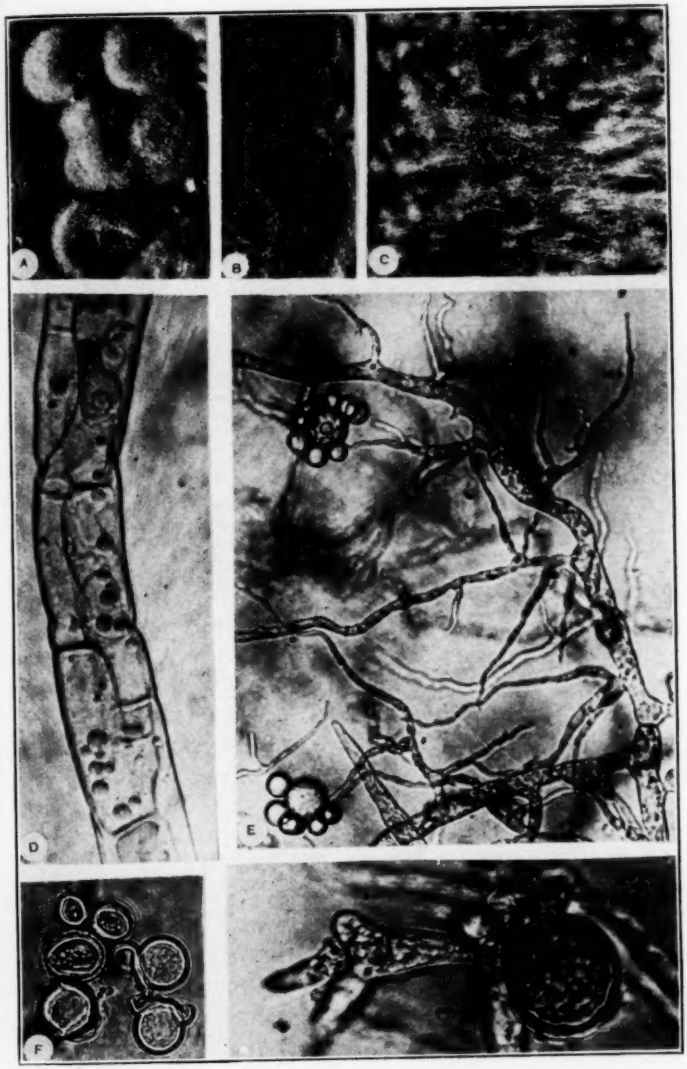
PLATE 2

Fig. *A*, An early stage in the formation of a fruiting body, showing the dilated extremity of the filament and the dense granular protoplasm. × 300; *B*, A head in the process of development, partially covered with conidia.

Some sterigmata are noticeable. A group of spherical bodies is also present. × 500; *C*, A more advanced stage in the development of the capitellum. × 130; *D*, A mature cat-tail-like head, with some of the conidia detached; *E*, A portion of a naked capitellum showing the sterigmata from which the spores have fallen; *F*, Portion of a naked collapsed capitellum from which the conidia have fallen, showing the spiral arrangement of the sterigmata as diagonal rows. A few conidia with sterigmata adhering are also shown; *G*, A capitellum showing secondary heads which frequently develop when the organism is grown on a very rich medium; *H*, Septation of the conidiophore which occurs after maturity is reached. A capitellum with spores detached is also shown. × 230.

PLATE 3

Fig. *A*, Colonies of the fungus showing the compact growth. Natural size; *B*, A section of a plate culture showing zoning. Natural size; *C*, A portion of a plate culture showing the heliotropic nature of the fungus. Natural size; *D*, Self-penetration or "Durchwachsungen"; *E*, Two spherical bodies surrounded by a number of pseudogemmae. The lack of uniformity in the diameter of the hyphae is also shown. × 330; *F*, Endogenous portion of a spherical body, breaking away from encompassing wall; *G*, One type of spherical body with club-like structure attached, frequently found submerged in agar.



MYCOTYPHA MICROSPORA

PHOMA CONIDIOGENA ON BOX

MARJORIE E. SWIFT

(WITH PLATE 4 AND 2 TEXT FIGURES)

A distinctive leaf tip blight of two bushes of *Buxus sempervirens* var. *angustifolia* Linn. was noted in the late summer of 1930 in The New York Botanical Garden boxwood collection. The leaves of the current year's growth, as well as older ones, were affected. The necrotic area was always at the extreme tip of the leaf and contrasted markedly with the healthy portion because of its ashy gray color and very thin texture. It was separated from the green portion of the leaf by a very narrow dark band made up of alternating gray, black and brown lines (PLATE 4, A). Small dark brown to black ostiolate pycnidia were scattered irregularly on both surfaces of the dead area (PLATE 4, B, C).

In October of the same year the trouble was observed in another planting considerably removed from the first. The only variety affected was again *Buxus sempervirens* var. *angustifolia*. Spores from these plants were still viable in February, 1931, after having weathered winter conditions.

The bushes on which the fungus was first seen again furnished abundant material in the spring of 1931, but only on old leaves. Not until September was the new growth found affected.

The fungus is not confined to the leaves, but was also found in defoliated dying twigs. Fruit bodies were not observed in these instances, but the fungus was isolated from internal tissue.

THE FUNGUS

Measurements of pycnidia and spores from leaves, before culturing, led to classification of the fungus as *Phyllosticta Auerswaldii*,[1] which was described as causing a white spot particularly at the tips of *Buxus sempervirens* leaves, with fruit bodies

[1] Allescher, Andreas. Fungi imperfecti. In Rabenhorst's Krypt.-Fl. 1[6]: 25. 1901.

scattered on the upper surface. The boxwood fungus met this description in every way except that pycnidia occurred on both surfaces of the leaf. Culture work, however, made necessary a different classification.

Isolations were made both from pieces of affected tissue surface-sterilized with mercuric bichloride and from single pycnospores. Within twenty-four hours pycnidia like those seen on the leaves were beginning to form upon and within the agar (corn meal) in markedly radiating lines from the center of the darkening, greenish brown growth. Later rosy masses of spores oozed from the conspicuous ostioles in moist droplets, or in cirri under drier conditions (PLATE 4, G). After the third day dusky aerial hyphae became more abundant, and a new kind of spore was observed in chains here and there about the periphery of the colony. They were of the dark muriform *Alternaria* type and were thought at first to represent a contaminant, although their relation to the rest of the culture did not suggest such a conclusion (PLATE 4, H, I). To determine whether or not they belonged to the boxwood fungus they were picked off and grown singly. The resulting cultures were identical with those obtained from the single pycnospores. Repeated monospore cultures of both the *Alternaria* and the *Phoma* spores have since been made and all cultures (except a "mutant" to be described later) have produced both types of spores. Examination of the affected leaf tips for any *Alternaria* spores showed only occasional chains of short rough brown cells in the diseased portions. However, when mycelium from pure cultures was placed on moist box leaves in test-tubes where the air was kept saturated, both types of spores were produced in abundance.

Examination of the literature has yielded no description of such a dimorphic fungus on boxwood. Schnegg[2] in 1915 described a similar fungus common in brewery liquids, and named it *Phoma conidiogena*. He studied in detail pycnidium formation, and considered the *Alternaria* spores, which were much less abundant in his cultures, merely as resting cells ("Dauerzellen").

[2] Schnegg, Hans. Zur Entwicklungsgeschichte und Biologie der Pycniden, sowie der Schlingenmycelien und Hyphenknäuel. Centralbl. Bakt., Parasit. Infekt. **43**: 326–364. 1915.

The boxwood fungus is, without question, a strain of *Phoma conidiogena*.

Brooks & Searle [3] in 1921 described another strain of the fungus as *Phoma alternariaceum*, isolated from rotting tomato fruits. They interpreted the dark catenulate bodies as true *Alternaria* spores. Chodat [4] studied their fungus with particular reference to mutations, but refers to the dark conidia as "hypnocysts"

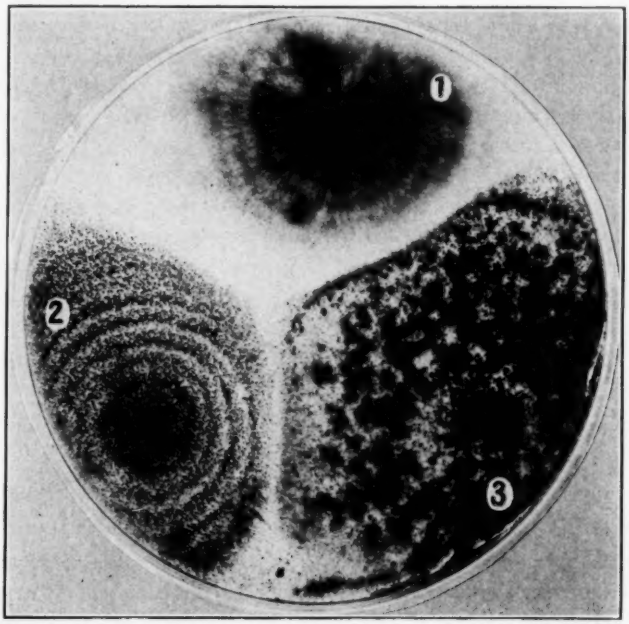


FIG. 1. Three strains of *Phoma conidiogena* one month old—1, from tomato fruit (Brooks & Searle's *P. alternariaceum*); 2, from cellar air (Benham); and 3, from boxwood.

and not true conidia, on the ground that they are found in the internal hyphae as well as aerially and are merely nutritive. Our cultures show only thickened dark mycelial cells in the sub-

[3] Brooks, F. T. & Searle, G. O. An investigation of some tomato diseases. Trans. Brit. Myc. Soc. **7**: 173–197. 1921.

[4] Chodat, Fernand. Recherches expérimentales sur la mutation chez les champignons. Bull. Soc. Bot. Genève, II, **18**: 41–144. 1926.

merged hyphae. In none of Chodat's strains, however, did he describe the hypnocysts in such numbers as they occur in the boxwood fungus. His stock culture produced hypnocysts in a little more than a month, and his most fertile mutant in fifteen days. The boxwood fungus produces them in three or four days in abundance (PLATE 4, H, I).

A culture of the Brooks and Searle *Phoma alternariaceum* was obtained from the Centraalbureau voor Schimmelcultures at Baarn, Holland, for the purpose of comparison with the present form. No spores of any kind, however, have been produced, although the fungus has been grown on dextrose, potato dextrose, Czapek, prune, malt and corn meal agar, on boxwood leaves, potato tubers and tomato fruits (FIG. 1). Nothing but brown thick-walled mycelial enlargements have appeared.

A similar *Phoma* has been isolated by Benham [5] from cellar air in connection with asthma investigations at the Laboratory of Medical Mycology, College of Physicians and Surgeons, Columbia University. Her paper presents in detail the taxonomic features of this type of fungus.

These three strains are shown in figure 1 after a month's growth on a corn meal agar plate. Whether such differences as are evident here in gross culture should constitute species distinctions is questionable, since they are not more than exist between mutant strains.

CULTURE CHARACTERISTICS OF THE BOXWOOD STRAIN

On Corn Meal Agar: Colony spreading, at first hyaline and submerged, becoming dusky greenish brown with shadowy aerial hyphae particularly at the periphery; in age completely black with tufts of aerial hyphae throughout. Pycnidia developing quickly within and upon the agar in lines radiating from the center of the colony; conspicuously ostiolate, dark brown to black; their numerous pink spores exuded in droplets and giving the center of the culture a moist rose-colored appearance for a few days, then becoming drab and superseded by dark clumps of aerial hyphae and chains of *Alternaria* spores, which appear within three days.

[5] Benham, Rhoda. Phoma conidiogena. Bull. Torrey Club **58**: 203–214. 1931.

On Dextrose Agar: Culture consistently rose-colored and moist with masses of pycnospores; fading somewhat with age. Submerged hyphae hyaline. No aerial hyphae and no *Alternaria* spores.

On Potato Dextrose Agar: Colony at first rose-colored with moist masses of pycnospores, becoming black with age. No aerial hyphae and no *Alternaria* spores.

On Czapek's Agar: Similar to colonies on corn meal, but with

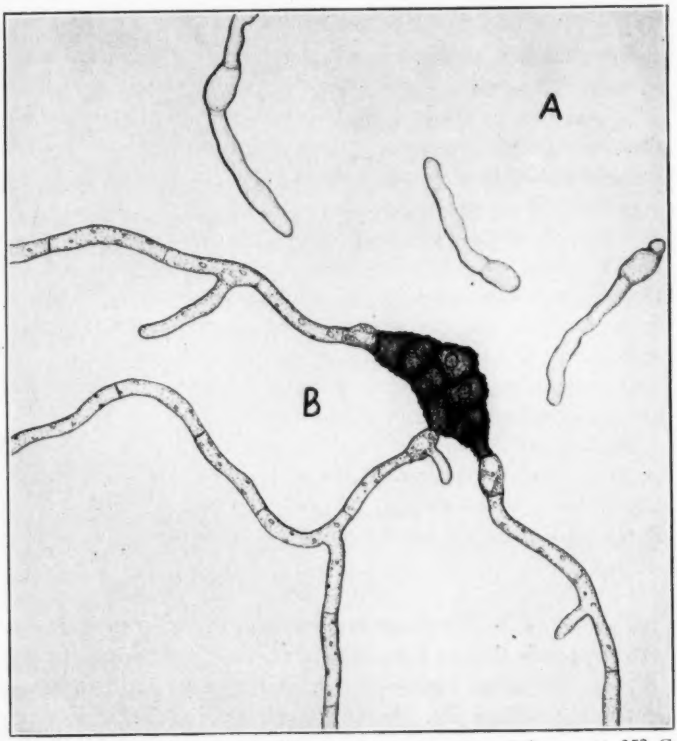


FIG. 2. Germinating spores after ten hours on corn meal agar at 25° C A, *Phoma;* B, *Alternaria* (× 1000).

more abundant and lighter-colored aerial hyphae. In age becoming entirely black and crusted.

Spore Germination: On corn meal agar the pycnospores are

slower to germinate than the *Alternaria* spores. They start growing within eight hours, when incubated at 25° C., sending out one to several germ tubes, as illustrated in figure 2, which soon begin to septate and branch. Germination tubes break through the thick wall of the dark *Alternaria* spore within five hours. Any or all of the cells of the spore may produce a tube. Figure 2 shows the two kinds of spores from the same single spore culture after they had been incubated at 25° C. for ten hours.

MORPHOLOGICAL FEATURES

Pycnidia dark brown to black, ostiolate, 37–150 μ in diameter, average 72.6 μ, with ostiolate portion often forming a neck about 33 μ long; developing in radiate formation. Pycnospores abundant, at first rosy in mass, becoming drab, individuals hyaline, irregularly oval to elliptical, often bi-guttulate, average 5 $\times$ 2.5 μ (PLATE 4, F).

Alternaria spores dark brown to black, rough-walled, average 36.6 $\times$ 13.6 μ (often much larger), with 4–9 transverse and 2–5 longitudinal walls, produced in abundantly branching chains in dark entangled clumps, often growing directly from pycnidium wall (PLATE 4, D, E, H, I).

Mycelium hyaline to dark greenish brown with *Oidium*-like chains of thickened cells in old cultures.

Pycnidial stage found on dead tips of leaves and on dead twigs of *Buxus sempervirens* var. *angustifolia* in The New York Botanical Garden. Specimens and cultures deposited in The New York Botanical Garden Herbarium and Fungus Culture Collection.

MUTANTS

Chodat [4] reports frequent mutations in his cultures of *Phoma alternariaceum* Brooks & Searle, expressed by sectoring of plate colonies into areas contrasting in degree of fertility, character of aerial mycelium, etc. His stock culture produced a more fertile sector after thirteen months of culturing. In view of this record the present cultures were watched for any such phenomenon. After nine months of frequent transferring, including three months in storage at approximately 45° F., a case of sectoring was noted. In a plate transfer from a single *Alternaria*

spore culture, a portion representing about one-third of the colony remained almost sterile, with considerable white flocculent aerial hyphae contrasting sharply with the rest of the growth which was of the normal greenish-brown color with both *Phoma* and *Alternaria* spores. A transfer from this sterile portion to another plate showed after several days three dark brown pycnidia at the center of the colorless colony. After a month the mycelium gradually took on a slightly dusky greenish color with aggregations of dark submerged mycelium and white aerial tufts, but no further tendency toward fertility has appeared in any of its subcultures on corn meal agar. On dextrose and potato dextrose agar, however, abundant pycnidia are produced. No *Alternaria* spores have been observed on any medium.

Fifteen single spore cultures from a pycnidium of the first subculture of this "sterile" sector developed into hyaline submerged colonies with the vortex-type of growth described by Schnegg [2] for his fungus. Pycnidia with spores developed in four days, but little aerial mycelium and no *Alternaria* spores were present. After several months in culture these colonies have darkened and look much like the original stock strain, except for the lack of *Alternaria* spores. Further single spore cultures are identical.

If these strains appear in artificial culture, they might be expected also to occur in nature. All isolations from boxwood have been approximately alike except one made in May, 1931. In this case the pycnidia are somewhat larger, less abundant, less regularly arranged on the radiate hyphae, and more frequently suspended in the aerial growth than in any other culture. The *Alternaria* type of spore is much less abundant.

INOCULATIONS

Attempts have been made to reproduce the spotting on the boxwood leaves both indoors and outdoors without success. In one instance the fungus was re-isolated after two weeks from a small necrotic area about the point of inoculation, but typical symptoms did not develop. It would seem that only under certain conditions perhaps of the host as well as of its environment will the fungus affect boxwood tissue. Moreover, since the leaf spot is apparently limited to one variety, and since new growth

is not attacked early in the season even on bushes where the older leaves are generally affected, the fungus must be considered only a weak parasite taking hold, perhaps, after a primary injury of some sort.

SUMMARY

1. A strain of *Phoma conidiogena* Schnegg was isolated from dead leaf tips and from blighted twigs of *Buxus sempervirens* var. *angustifolia* at The New York Botanical Garden. The necrotic areas on the leaf are at the extreme tip, ashy white, very thin and dried, and show ostiolate pycnidia on both surfaces.

2. New leaves are not quickly infected and the fungus appears to be only weakly parasitic on old weakened tissue.

3. Single spore cultures of the fungus produce spores of both the *Phoma* and *Alternaria* types. Other strains of this fungus have been reported as present in brewery liquids, rotting tomato fruits and cellar air, but no previous record of its occurrence on boxwood has been found.

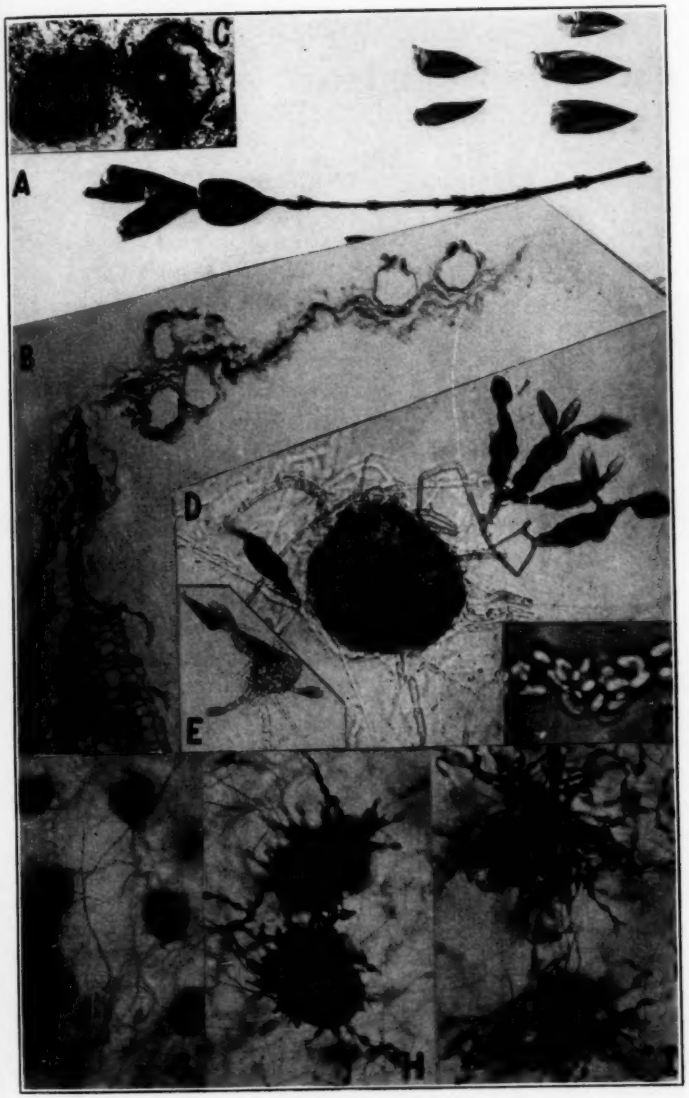
4. Sectoring occurred in a single spore plate culture after nine months of transferring. Subcultures from the almost sterile sector develop very few pycnidia on stock corn meal agar as compared with the original strain, and no *Alternaria* spores on any medium. Single spore cultures from these pycnidia show vegetative characteristics very similar to the original strain, but still consistently lack the *Alternaria* type of spore.

The helpful suggestions of Dr. B. O. Dodge in the preparation of this paper are gratefully acknowledged.

THE NEW YORK BOTANICAL GARDEN

EXPLANATION OF PLATE 4

A, Boxwood leaves infected with *Phoma conidiogena*. *B*, Section of diseased leaf tip. (× 350.) *C*, Pycnidia on leaf tissue. (× 200.) *D*, *Alternaria* spores and *Phoma* pycnidium from single spore culture. (× 400.) *E*, Same as *D*. (× 250.) *F*, *Phoma* spores. (× 1000.) *G*, Ostiolate pycnidia in young culture with masses of discharged spores. (× 100.) *H*, *Alternaria* spore chains growing from pycnidia in older culture. (× 100.) *I*, Tufts of aerial *Alternaria* spores in old culture. (× 100.)



PHOMA CONIDIOGENA

PHYSIOLOGIC SPECIALIZATION IN PUCCINIA EATONIAE

E. B. MAINS[1]

In 1903, Arthur (1904) noted the association of aecia (*Aecidium Ranunculi* Schw.) on *Ranunculus abortivus* L. with uredinia on the grass *Sphenopholis pallens* (Spreng.) Scribn. (*Eatonia pennsylvanica* A. Gray). He sowed aeciospores from *Ranunculus abortivus* on rust-free plants of *Sphenopholis pallens* in the greenhouse and obtained uredinia and, later, telia. Arthur noted that this was one of the numerous grass rusts passing under the name of *Puccinia rubigo-vera* (DC.) Wint. Since the name *Puccinia Ranunculi* was preoccupied, he proposed the name *Puccinia Eatoniae* for this rust.

EXPERIMENTAL RESULTS

The teliospores of most of the rusts of the *rubigo-vera* group usually germinate in the spring following their production, after having overwintered. The aecia of most of these rusts are usually localized and are produced in about 10 to 14 days after inoculation. The teliospores of *Puccinia Eatoniae* germinate in late summer or autumn of the year in which they develop and infection of the aecial host must occur, if at all, at that time. Aecia are found in the spring arising from a systemic mycelium. The rust, therefore, must pass the winter as mycelium in the *Ranunculus* host. In order to complete the studies of Arthur and obtain more information concerning this portion of the life history, it was decided to attempt cultures from the teliospores to *Ranunculus abortivus*. Two collections of telia were used for this purpose.

Telia of the first lot were collected on *Sphenopolis pallens* near Lafayette, Indiana, on June 17, 1920. These were stored out

[1] These studies were made while the writer was located in the Agricultural Experiment Station of Purdue University and were part of the coöperative investigations between that institution and the Office of Cereal Crops and Diseases of the United States Department of Agriculture.

doors and tested at intervals until September 16, when the teliospores showed germination. The germinating teliospores were used to inoculate young plants of *Ranunculus abortivus*, *R. californicus* Benth., *R. sceleratus* L., *R. Cymbalaria* Pursh., *R. acris* L., and *R. repens* L., all of which are known to be aecial hosts of grass rusts of the *rubigo-vera* type. Seven plants of noninoculated *R. abortivus* were kept as checks. The plants were retained in the greenhouse. During the autumn and early winter no sign of infection was noted. On January 3, 1921, several of the inoculated plants of *R. abortivus* showed thickening of some of the leaves. On January 28, pycnia showed on some of the lower leaves of a few of the plants. Finally, 11 of the 15 inoculated plants of *R. abortivus* showed pycnia occurring on most of the leaves of the rosette. In most cases all of the leaves were involved. Occasionally a few leaves were free or only partially invaded. With the development of pycnia a fragrant odor was noted.

Aecia were first noted on March 21 and their development advanced rapidly until the lower surfaces of most of the leaves were covered. None of the noninoculated check plants of *R. abortivus* developed rust. The inoculated plants of *R. californicus*, *R. sceleratus*, *R. Cymbalaria*, *R. acris*, and *R. repens* did not develop infection.

Telia of the second collection were obtained by Prof. H. S. Jackson, July 1, 1920, at Vincennes, Ind. Nine plants of *R. abortivus* were inoculated from germinating teliospores of this collection on September 16, 1920. Two plants showed a few pycnia on October 26 but during November and December further development of the rust apparently ceased. On January 28, 1921, all nine plants had pycnia on the lower leaves, followed soon by their appearance on the other leaves of the rosettes. Aecia were first noted March 21 and soon afterward they covered the lower sides of infected leaves.

Aeciospores from the second series of cultures were used to inoculate a series of grasses. On March 26, they were sown on 10 or more seedlings of *Alopecurus pratensis* L., *Arrhenatherum elatius* (L.) Beauv., *Festuca ovina* L., *F. rubra* L., *Dactylis glomerata* L., *Poa palustris* L., *P. trivialis* L., *Puccinellia Nuttalliana*

(Schultes) Hitchc., *Sphenopholis obtusata* (Michx.) Schribn., and *S. pallens*. Uredinia developed only on *S. pallens* which showed an abundant infection, April 7, 1921.

Urediniospores from the rust thus obtained on *S. pallens* were sown April 21 on seedlings of *Danthonia californica, Deschampsia flexuosa* Trin., *Notholcus lanatus* (L.) Nash, *Panicularia elata* Nash, *Poa palustris, Puccinellia Nuttalliana, Sphenopholis obtusata* and *S. pallens*, with development of uredinia only on *S. pallens*.

In May, 1921, H. W. Anderson collected the aecial stage of a rust near Odin, Ill., on *Myosotis virginica* (L.) B.S.P. The aecia covered the lower sides of most of the leaves and apparently arose from a systemic mycelium. H. S. Jackson determined this collection as *Aecidium Myosotidis* Burr. This *Aecidium* was described by Burrill (1884) from a collection made at Cobden, Ill., by A. B. Seymour, April 13, 1882. Since the material in the Arthur Herbarium was fragmentary, Jackson asked Anderson to compare his collection with the type material at the University of Illinois. This was done and the rust was found to agree with the type of *Aecidium Myosotidis* and with several other collections made by Seymour at Cobden and Makanda, Illinois, during April, 1882.

The systemic aecia on *Myosotis* immediately suggested the similar aecia on *Ranunculus abortivus*. Since among the grass rusts of the *rubigo-vera* type there exists a number of very similar types some of which have aecia on Boraginaceous hosts and others on species of Ranunculaceae, this suggested a grass as the alternate host with the possibility that it might be *Sphenopholis*. Consequently, Professor Anderson was asked to look for rust on other plants in the vicinity of the rusted *Myosotis*. He very kindly did so and sent in two grasses bearing uredinia. One of these proved to be *Sphenopholis obtusata* and the rust resembled *Puccinia Eatoniae*.

Fortunately, Professor Anderson was able to obtain fresh aecia on *Myosotis virginica* at Odin, Illinois, which he sent to us. On May 16, aeciospores were sown on seedlings of *Sphenopholis obtusata*. A few uredinia developed on May 26 and the spores from these were sown on other plants of *S. obtusata*, resulting in

abundant infection. During the summer this rust was resown several times upon the same plants resulting finally in the production of abundant telia.

The rust was tried also on a number of other grasses. On August 24, urediniospores from *Sphenopholis obtusata* were sown on seedlings of *Koeleria cristata* (L.) Pers., *Arrhenatherum elatius*, *Notholus lanatus*, *Bromus inermis* Leyss., *B. tectorum* L., and *Sphenopholis obtusata* resulting in the production of uredinia only on *S. obtusata*.

On September 7, urediniospores from *S. obtusata* were sown on *Avena barbata* Brot., *A. fatua* L., *Bromus inermis*, *B. tectorum*, *Deschampsia caespitosa* (L.) Beauv., *Secale cereale* L. (Petkus variety), *Sphenopholis obtusata* and *S. pallens* resulting in the production of uredinia only on *S. obtusata* and *S. pallens*.

Teliospores developed on *Sphenopholis obtusata* were germinated in November and were used in the greenhouse on November 3 to inoculate seedlings of *Myosotis virginica*. The teliospores, still germinating, were used for a second series of inoculations December 3, on both *Myosotis virginica* and *Ranunculus abortivus*. A third inoculation was made December 20 on *Myosotis virginica*.

The first signs of infection were noted with the renewal of vigorous growth in January. The shoots of infected plants were more elongated than those of the check plants. Pycnia first appeared February 25, 1922, on plants of *Myosotis* from the second inoculation. By March 6, pycnia were showing on all of the plants of *Myosotis* from all three inoculations. The infected plants soon showed pycnia covering most of the leaves of the inoculated *Myosotis virginica*. The development of pycnia was accompanied by a fragrant odor as noted for *Ranunculus abortivus*. Aecia were first noted April 14 and soon covered the lower sides of the leaves of infected plants. All 15 plants of the inoculated *Myosotis virginica* produced abundant systemic infection, while the 5 noninoculated check plants showed no sign of rust. The 7 inoculated plants of *Ranunculus abortivus* showed no infection.

Aeciospores from *Myosotis virginica* were sown on *Sphenopholis obtusata* April 20 and abundant uredinia were produced by April 30.

TAXONOMIC POSITION

It has been suggested that many of the grass rusts, such as *Puccinia triticina* Eriks., *P. Elymi* Westend., *P. Agropyri* Ellis & Ev., *P. persistens* Plowr., *P. cinerea* Arth., etc., of very similar morphology, should be united under one specific designation. Thus, Arthur and Fromme (1920) have united such grass rusts having Ranunculaceous aecia under *Dicaeoma Clematidis* (DC.) Arth. Cunningham (1923) has concurred in this but considers that the name *Puccinia Elymi* should be used, since *Aecidium Clematidis* DC. was based on an aecial stage. Mains and Jackson (1926) have suggested that the closely similar grass rusts having aecia on species belonging to the Boraginaceae (*Puccinia dispersa* Eriks. & Henn., *P. bromina* Eriks.), Hydrophyllaceae (*P. apocrypta* Ellis & Tracy) and Balsaminaceae (*P. Impatientis* (Schw.) Arth.) also should be included and have suggested a return to the earlier name *Puccinia rubigo-vera* (DC.) Wint. As so used it does not include the species *Puccinia glumarum* (Schmidt) Eriks. & Henn. and *Puccinia anomala* Rostr. which were formerly included.

Morphologically, the rusts of *Sphenopholis-Ranunculus* and of *Sphenopholis-Myosotis* do not differ markedly from the majority of the rusts of the *rubigo-vera* group. They have globoid or ellipsoid urediniospores with six or more scattered germpores, and teliospores that remain covered for some time by the epidermis. While the teliospores of most of the rusts of the *rubigo-vera* group usually do not germinate until spring, the early germination of the teliospores of *Puccinia Eatoniae* finds its counterpart in the leaf rust of rye. However, in the production of pycnia and aecia from a systemic mycelium *Puccinia Eatoniae* differs sufficiently from *Puccinia rubigo-vera* to be maintained as a separate species. It is, however, a very closely related species, as is shown by its general morphology and by the occurrences of races in both species having aecia on Ranunculaceous and Boraginaceous hosts.

A comparison of *Puccinia Eatoniae* derived from *Ranunculus* and *Myosotis* shows a very close agreement in morphology as well as development. This can be noted by comparing the following descriptions. The rust from *Ranunculus* has much longer teliospores, 28–50 μ, as compared with 23–35 μ of that from *Myo-*

sotis. Whether this difference will be maintained when more extensive material is available is a question which must await further study. For the present it seems best to consider these rusts as separate varieties of *Puccinia Eatoniae*, that with aecia on *Ranunculus abortivus* being designated as *Puccinia Eatoniae* var. *Ranunculi* and that with aecia on *Myosotis virginica* as *Puccinia Eatoniae* var. *Myosotidis*.

Puccinia Eatoniae var. **Ranunculi** (Schw.) comb. nov.

Syn. *Aecidium Ranunculi* Schw.

O. Pycnia scattered over large areas of the leaves from a systemic mycelium.

I. Aecia hypophyllous accompanying the pycnia, cupulate, up to 0.6 mm. in diameter; peridium colorless, short, the margin slightly recurved; peridial cells rhomboidal 12–24 × 21–31 μ; aeciospores globoid or ellipsoid, 12–17 × 15–24 μ, the wall colorless, about 1.5 μ thick, finely verrucose.

On *Ranunculus abortivus*

II. Uredinia scattered on the leaves, small 0.3–0.7 mm. long, cinnamon-brown; urediniospores ellipsoid or globoid, 15–19 × 19–25 μ; wall yellow, 1–1.5 μ thick, closely and finely echinulate, the pores 6–8, scattered.

III. Telia scattered on leaves and leaf sheaths, 0.3–0.7 mm. long, brownish black, long covered by the epidermis; teliospores surrounded by brown stromal hyphae, germinating during the season when produced; oblong-clavate 13–22 × 28–50 μ, rounded or flattened at the apex, the wall thin 1 μ, light chestnut brown, thickened at the apex up to 6 μ; pedicel short.

On *Sphenopholis pallens*. Rather widely distributed throughout the eastern United States.

Puccinia Eatoniae var. **Myosotidis** (Burrill) comb. nov.

Syn. *Aecidium Myosotidis* Burrill.

O. Pycnia scattered over large areas of the leaves from a systemic mycelium.

I. Aecia hypophyllous accompanying the pycnia, cupulate, up to 0.6 mm. in diameter; peridium colorless, short, the margin slightly recurved; peridial cells rhomboidal, 17–23 × 26–28 μ;

aeciospores angularly globoid, 15–20 × 18–25 μ; wall colorless, about 2 μ thick, finely verrucose.

On *Myosotis virginica*

II. Uredinia on the leaves, scattered, small, light cinnamon-brown; urediniospores broadly ellipsoid 15–21 × 19–25 μ; wall pale brown, about 1.5 μ, finely echinulate, the pores 6–8 scattered, indistinct.

III. Telia on the leaves and leaf sheaths, scattered, brownish black, long covered by the epidermis, germinating during the season when produced, oblong-clavate, 13–18 × 25–35 μ, often flattened at the apex; wall thin, about 1 μ, light brown, thickened at the apex up to 3 μ, chestnut brown; pedicel short.

On *Sphenopholis obtusata* and *S. pallens*

Judging from the distribution of the aecia (Arthur, 1926), this variety occurs in Indiana, Illinois, Missouri, and Wisconsin.

SUMMARY

Puccinia Eatoniae has been shown to contain two varieties which have been designated as *Ranunculi* and *Myosotidis*.

Puccinia Eatoniae var. *Ranunculi* produced aecia on *Ranunculus abortivus* but not on *Ranunculus californicus*, *R. scleratus*, *R. Cymbalaria*, *R. acris* nor *R. repens*. Infection from basidiospores takes place in late summer or early autumn and aecia develop from a systemic mycelium the following spring. Uredinia and telia were produced on *Sphenopholis pallens* but not on *Alopecurus pratensis*, *Arrhenatherum elatius*, *Dactylis glomerata*, *Danthonia californica*, *Deschampsia flexuosa*, *Festuca ovina*, *F. rubra*, *Notholcus lanatus*, *Panicularia elata*, *Poa palustris*, *Poa trivialis*, *Puccinellia Nuttaliana*, nor *Sphenopholis obtusata*.

Puccinia Eatoniae var. *Myosotodis* produced aecia on *Myosotis virginica* but not on *Ranunculus abortivus*. Teliospores germinated in late summer and early autumn and aecia developed from a systemic mycelium the following spring. Uredinia and telia were produced on *Sphenopholis obtusata* and *S. pallens*, but not on *Avena barbata*, *A. fatua*, *Bromus inermis*, *B. tectorum*, *Deschampsia caespitosa*, *Koeleria cristata*, *Notholcus lanatus* nor

Secale cereale. This variety also was found to have shorter teliospores than the variety *Ranunculi.*

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ON CERTAIN SPECIES OF HETEROTEXTUS

G. W. MARTIN

(WITH PLATE 5)

The genus *Heterotextus* was proposed by C. G. Lloyd [1] to include certain dacryomycetaceous fungi previously referred to *Guepinia*, but differing from typical members of that genus, as it has ordinarily been understood, in the possession of a firm cortical layer composed of swollen, bottle-shaped or subcylindrical cells arranged in a palisade layer and quite distinct from the loosely interwoven and highly gelatinized tissue composing the interior of the basidiocarp. The first species mentioned is *H. flavus* Lloyd, from Tasmania, described as new. Lloyd also transfers to his new genus *Guepinia pezizaeformis* Berk., *G. monticola* Tracy and Earle and *G. occidentalis* Lloyd.

In the coniferous forests of the Rocky Mountains of Colorado and Wyoming, one of the commonest fungi occurring on decorticated logs of *Picea* and *Abies* is a cupulate dacryomycetaceous form clearly belonging to Lloyd's genus. The attempt to name abundant collections in the herbarium of the State University of Iowa brought out the confusion existing in this group of species. The specimens were in part collected by myself in the Medicine Bow Mountains, Wyoming, in August, 1929; in part by Mr. R. W. Davidson of the United States Department of Agriculture, in Colorado, in June and July 1930.

In 1905, Tracy and Earle [2] described *Guepinia alpina* and *G. monticola* from the mountains of southwestern Colorado, where both were growing on the wood of *Picea Engelmanni*. According to the original descriptions the two species are very nearly alike. Both are said to be cup-shaped, short stipitate, of about the same size and with similar basidia and spores. It is true the description says of *alpina*, "basidia . . . forking at base," and of *monticola*, "basidia forking near the upper end," but I interpret this

[1] Myc. Notes **7**: 1151. 1922.

[2] Fungi. *In* Greene, Plantae Bakerianae **1**: 23. 1901.

to mean merely that the basidia of *G. alpina* were younger and cylindrical, and hence their tufted habit was more apparent in a crushed mount. Since the spores of both were described as unseptate, they must have been immature. This is stated for *G. alpina* and there is a question mark after "continuous" in the case of *G. monticola*. *G. alpina* is said to be orange yellow, *G. monticola* "ferruginous," but the condition when collected and the manner of drying often affects the color of both fresh and dried specimens belonging to this family. So far as the descriptions are concerned, therefore, the only significant difference is the character of the vesicular hairs which clothe the outer part of the fructification, those of *G. alpina* being described as "50 × 16 μ, simple or sometimes once septate and constricted, minutely roughened"; those of *G. monticola* as "50 μ long with base globose, 20–25 μ wide, abruptly compacted above into a long beak." The outside of the cup of *G. alpina* is said to be pruinose, that of *G. monticola* "sulcate ribbed, surface scarcely distinguishable from the hymenium."

Through the kindness of Dr. David H. Linder I have been permitted to examine co-types of both species from the herbarium of the Missouri Botanical Garden, and Dr. Bessie B. Kanouse courteously loaned me all material ascribed to these species in the University of Michigan herbarium. Examination of these specimens confirms the conclusion arrived at from examination of our own abundant material, that the differences as given are not constant, but represent slightly different phases of a single species. The pruinose character of the outer margin varies with the age and state of development of the fructification, while hairs of all sorts forming a completely connected series may be found in a single mount, almost in a single cluster (PLATE 5, FIGS. 3, 4, 11, 15). In the Michigan herbarium there is a collection made by J. R. Weir in Bonner County, Idaho, June, 1920, labelled by Dr. Weir "*Dacryomyces alpina* Tracy and Earle, subsp. of *D. monticola* T. & E." This is clearly *Guepinia alpina* T. & E. Dr. Weir further notes on the packet that *G. alpina* is "olive yellow," *G. monticola*, "amber, no yellow." As already suggested, great variation in color may be noted in the fructifications of different ages in the same cluster.

In my opinion, *Heterotextus*, as defined by Lloyd, is a good genus, readily distinguished from other genera of the Dacryomycetaceae by the character given. *Guepinia alpina* and *G. monticola* are described on the same page, but since *G. alpina* comes first it has priority. Curiously enough, Lloyd failed to include *G. alpina* in his list of species transferred to *Heterotextus*. I have the less hesitation in making this transfer, since it seems clear that *Guepinia* of Fries is a genus of the Tremellaceae. The only species cited in the original description [3] is *G. helvelloides*, which is evidently the large infundibuliform fungus more generally known by Persoon's name as *Gyrocephalus rufus*. This citation is confirmed in the Elenchus Fungorum (**2**: 30), where it is the first of two species of *Guepinia* cited, the second being *G. spathularia*. Since *G. helvelloides* (*i.e. Gyrocephalus rufus*) has cruciate-septate basidia, it must be included in the Tremellaceae, and Patouillard was wholly justified, by any reasonable interpretation of the International Code, in transferring *Guepinia spathularia* and related species with forked basidia to his new genus *Guepiniopsis*. Lloyd believes (Myc. Notes **7**: 1143) that Fries misapplied the specific name, but even if this were so, and it can scarcely be said to have been demonstrated, the interpretation would be unaffected. I therefore propose the following combination to designate the Rocky Mountain species:

Heterotextus alpinus (Tracy & Earle) comb. nov.

Fructification cup-shaped, becoming expanded, bright orange to amber or pallid when moist, deep orange red when dry; 3–10 mm. in diameter when moist, and about the same in depth, exterior more or less sulcate ribbed, the exterior of the expanded portion roughened and more or less tuberculate; hymenium concave, smooth or nearly so, composed of forked basidia 40–50 μ long before branching and 4–5 μ thick; cortex composed of a palisade layer of vesicular hairs, mostly 40–75 μ in length and 15–20 μ thick, varying from broadly pyriform to nearly cylindrical, with a small lumen, and thick, gelatinized walls, rough exteriorly, often elongated at the apex into a beak; interior of fructification composed of loosely interwoven, extremely gelatinous hyphae,

[3] Syst. Orbis Veg. 92. 1825.

with numerous clamp connections; spores allantoid, apiculate, at first continuous, becoming 4-celled, 15–17.5 × 5–6 μ.

On *Picea Engelmanni* and *Abies* sp., Colorado, Wyoming, Idaho.

The tubercular character of the exterior is most apparent when the fructifications are not too moist (PLATE 5, FIGS. 1, 6). The hymenium is probably always inferior, but this cannot be determined positively from herbarium specimens. The clamp connections are very conspicuous, sometimes with a large open loop (PLATE 5, FIG. 5). The spore measurements as given in the original descriptions are 12 × 4 μ for *G. alpina*, and 12–16 × 4 μ for *G. monticola*. No septate spores were found in the co-type of *G. monticola*, and the largest immature spore measured was 16 × 5 μ (PLATE 5, FIG. 12). A few mature, 4-celled spores were found in the co-type of *G. alpina*. A typical example (PLATE 5, FIG. 16) measured 17 × 5.5 μ.

It is noteworthy that it was impossible to find septate spores in many of our own specimens, while in others, obviously more mature, 4-celled spores were abundant (PLATE 5, FIG. 8). Apparently the spores mature with unusual slowness.

Ditiola Shopei Coker, described from material collected on *Picea Engelmanni* in Colorado,[4] seems unquestionably the same as *Heterotextus alpinus*. Coker describes the spores as mostly not divided, some divided into two cells, rarely into four. The late appearance of completely divided spores has already been noted as characteristic of *H. alpinus*. Evidently, the spores are capable of germinating before final division, since Coker illustrates an unseptate spore and a 2-celled spore producing germ-tubes. This I have not observed.

Two specimens in the Michigan herbarium, collected by Dr. Kauffman at Lake Placid, N. Y., belong in *Heterotextus*. One was identified by Dr. Kauffman as *G. alpina*, the other as *G. monticola*. Part of the latter collection was evidently sent to Mr. Lloyd, since there is a note on the packet, "Lloyd suggests *G. alpina* or *G. pezizaeformis*." Both collections are clearly referable to the same species, and this cannot be *G. alpina*. The fructifications, although fully developed, are much smaller (PLATE

[4] Jour. Elisha Mitchell Soc. **46**: 117. 1930.

5, FIG. 17), and the cortical hairs are ovate to cylindrical and very much smaller than those of *G. alpina*, rarely exceeding 30 μ in length and 7–12 μ in thickness, and only occasionally with a blunt, beak-like apex (PLATE 5, FIG. 21). The spores, too, are smaller, about 13–14 × 5–6, and somewhat more curved (PLATE 5, FIGS. 19, 22). The specimens do agree very closely with the descriptions of *Guepinia Peziza* Tulasne as that species has been understood by recent authors, notably Schroeter [5] and Lloyd,[6] although Lloyd gives the spore measurements as 14 × 7 μ. I therefore refer them to that species.

Certainly *Guepinia Peziza*, as illustrated by its author,[7] is to be included in *Heterotextus*, if that genus is to be accepted. I do not wish to propose such a transfer, however, without having had the opportunity to study authentic material.

Heterotextus pezizaeformis (Berk.) Lloyd seems to have been reported only from Australia and New Zealand. Little can be told from Berkeley's brief diagnosis as given in Saccardo (**6**: 807) and Lloyd's comments are not always clear. It seems to be entirely too close to *Guepinia Peziza*, but Lloyd, who knew both species, thought them distinct. It is to be hoped that his material will be re-examined, and the differences, if such exist, be plainly stated.

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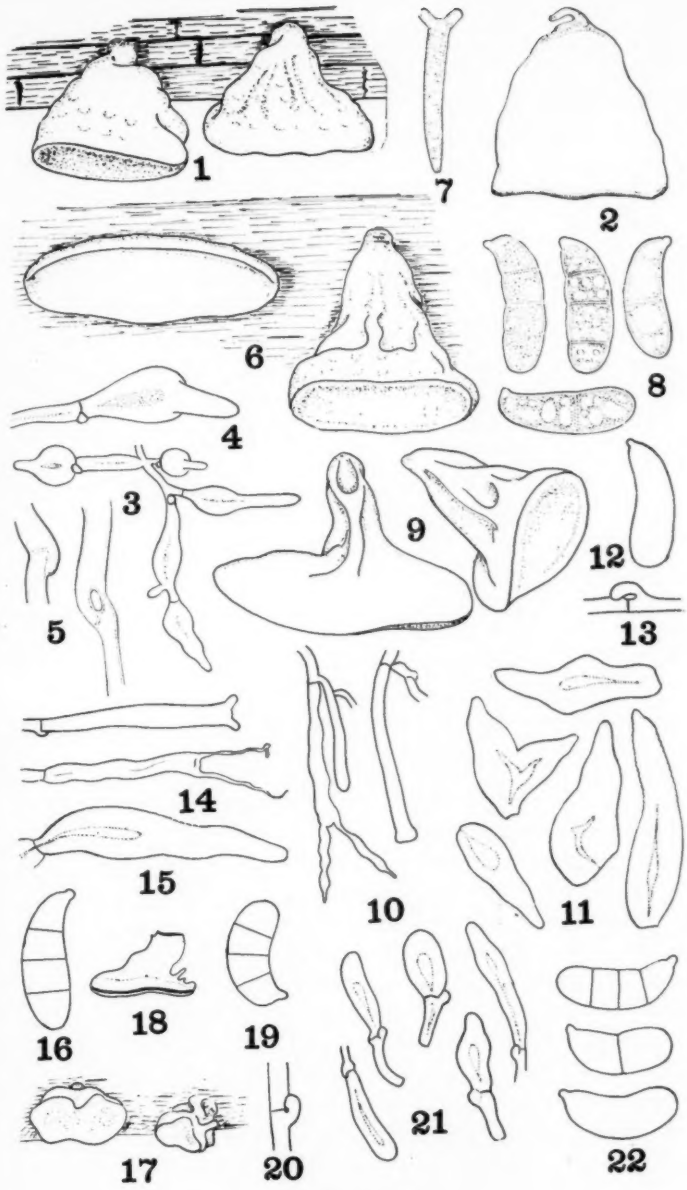
EXPLANATION OF PLATE 5

All figures showing microscopical details outlined with camera lucida and reduced in reproduction to magnification indicated.

Figs. 1–16, *Heterotextus alpinus:* 1, R. W. Davidson, No. 206, Colorado. Two basidiocarps, showing tuberculate character, × 5; 2, Same. Longitudinal section, showing internal zonation, × 5; 3, Same. Cluster of cortical hairs, showing variation, × 252; 4, Same. Cortical hair, × 505; 5, Same. Two clamp connections, one looped, × 1218; 6, G. W. Martin, No. 375, Wyoming. Two basidiocarps, one showing sulcate peridium, the other fully mature and broadly expanded, × 5; 7, Same. Basidium, × 505; 8, Same. Four spores, × 1218; 9, Co-type of *Guepinia monticola*. Two basidiocarps, × 5; 10, Same. Three basidia, one young, one ready to produce epibasidia, one

[5] Pilze Schlesiens. 1888.
[6] Mycological Notes **6**: 921. 1920.
[7] Ann. Sci. Nat. V. **15**: *Pl. 9*. 1872.

shrunken after having discharged spores; 11, Same. Five cortical hairs, showing variation, × 505; 12, Same. Spore, × 1218; 13, Same. Clamp connection, × 1218; 14, Co-type of *Guepinia alpina*. Two basidia, × 505; 15, Same. Cortical hair, × 505; 16, Same. Spore, × 1218; 17–22, *Guepinia Peziza;* 17, C. H. Kauffman, New York, as *Guepinia alpina*. Two basidiocarps, × 5; 18, Same. Longitudinal section of basidiocarp, showing internal zonation; 19, Same. Spore, × 1218; 20, Same. Clamp connection, × 1218; 21, C. H. Kauffman, New York, as *G. monticola*. Five cortical hairs, × 505; 22, Same. Three spores, × 1218.



HETEROTEXTUS

NOTES ON TROPICAL RUSTS WITH DESCRIPTIONS OF TWO NEW SPECIES

ROSS W. DAVIDSON

(WITH 2 TEXT FIGURES)

The following rusts with a few exceptions were taken from the residue of W. A. Kellerman's Guatemalan collections. Arthur (1) cites 112 of Kellerman's collections saying that there still remains a large number of his specimens that have not yet been studied. The writer has studied what seems to be some of this remaining material and from it 150 determinations have been made.

By checking these specimens with the numbers and dates given in Arthur's paper, it was found that many were duplicates of those already studied. In most instances all data except numbers and date of collection were missing. S. F. Blake identified many of the hosts and others were determined from the rust present.

The interesting rust on *Senecio* sp. was found by S. F. Blake while examining some specimens of plants from Venezuela.

Specimens of the two new species have been sent to Dr. Arthur and he also believes them to be undescribed.

1. **Chrysocyclus Senecionis** sp. nov. (FIG. 1)

On *Senecio* sp. From Trujillo, Venezuela. Collected by Christ (No. *101*) in 1927. Elevation 3,400–3,700 meters.

O. Pycnia hypophyllous, subepidermal, large, globose, 220–300 μ in diameter.

III. Telia on discolored spots 1–1.5 cm. across, hypophyllous, subepidermal, forming concentric circles around the pycnia, flat, slightly raised, dark cinnamon-brown, waxy in appearance, ruptured epidermis conspicuous; teliospores large, biapical from first (apex of lower cell arising below septum), 70–88 μ long, width (excluding apex of lower cell) 22–30 μ, width (including lower apex) 38–50 μ, length of upper cell 50–60 μ, from septum to base

22–32 μ, tapering slightly to the rounded apices, constricted at septum; wall uniformly 2–3 μ thick, light golden; pedicel hyaline, 12–18 μ thick, once to twice length of spore.

Pycnidiis hypophyllis, subepidermicis, globosis, 220–300 μ diam.; teliis maculis brunneis 1–1.5 cm. insidentibus, hypophyllis, subepidermicis, concentrice annuliformibus, applanatis, vix elevatis, cinnamomeo-brunneis, ceraceis, epidermide conspicue la-

FIG. 1. Teliospores of *Chrysocyclus Senecionis* (× 170).

cerata cinctis; teliosporis magnis, ab initio biapicalibus, 70–88 × 23–30 μ, ad rotundatos apices attenuatis, septo constrictis; tunica 2–3 μ aequaliter crassa, pallide aurantia; pedicello hyalino, 12–18 μ crasso, sporam aequante vel duplo longiore.

In foliis *Senecionis*, Trujillo, Venezuela.

This species differs from both *C. Cestri* (Diet. & Henn.) Sydow and *C. Mikaniae* (Arth.) Sydow by having much broader and longer spores. The spores also differ by tapering to the rounded apices, and by having medium thick slightly colored walls. The biapical "mitten-like" condition, which is the most outstanding character of this interesting rust, is also much more pronounced than in the other species.

Jackson (**5**) considers the method of germination of the telio-

spores of previously described species of *Chrysocyclus* to be very similar to that in a number of species of lepto-*Puccinia* and concludes therefrom that generic separation can not be based on this character. However, it is the writer's opinion that the "mitten-like" form of the spores and waxy appearance of the sori, which are usually arranged in concentric layers around the pycnia, together with the method of germination are characters sufficiently distinctive to justify continuing the present classification.

PREVIOUSLY DESCRIBED SPECIES OF CHRYSOCYCLUS

Chrysocyclus Cestri (Diet. & Henn.) Sydow, Ann. Myc. **23**: 322, 1925.

Puccinia Cestri Diet. & Henn. Hedwigia 295, 1902.

Chrysopsora Cestri Arth. Bull. Torrey Club **51**: 53, 1924.

Chrysocyclus Mikaniae (Arth.) Sydow, Ann. Myc. **23**: 324, 1925.

Chrysopsora Mikaniae Arth. Bull. Torrey Club **51**: 54, 1924.

2. CRASSOPSORA STEVENSII Sydow.

On *Fischeria* sp.? (Asclepiadaceae) Collected by W. A. Kellerman at Zacapa, Guatemala, Jan. 1, 1908.

This seems to be the first report of this rust occurring in Central America. F. L. Stevens (**10**) collected it on a species of Asclepiadaceae in British Guiana, and on *Echites tomentosa* Rafin. in Trinidad in 1922.

The host for this species belongs to the family Asclepiadaceae, but there is some doubt as to its generic position. S. F. Blake suggested *Fischeria* which is probably correct.

3. SPIRECHINA PITTIERIANA (P. Henn.) Arth.

On *Rubus* sp. Collected by W. A. Kellerman near Guatemala City, Guatemala, Jan. 1, 1907.

This species has not been reported from Guatemala before. It is characterized by its large spiny urediniospores.

4. RAVENELIA HUMPHREYANA P. Henn.

On *Caesalpinia pulcherrima* Sw. Collected by W. A. Kellerman at Aguacatan, Guatemala, Jan. 23, 1908.

This specimen is interesting because of the fasciation of the host tissue on which the rust occurs. The uredinia are scattered

abundantly on the distorted stems and on the floral parts. No previous account of the organism occurring on the stems or of its causing distortion in the host has been found. Kellerman (6) says, "No effect on the vitality or vigor of the host could be detected."

5. SKIERKA HOLWAYII Arth.

On *Thouinidium decandrum* Radlk. Collected by W. A. Kellerman in the Valley of Rio Sanarate, Guatemala, Feb. 18, 1907.

There was an abundance of material in this specimen but since leaves only were present a determination of the host seemed doubtful. However, with S. F. Blake's suggestion of the family Sapindaceae, the writer was able to check it with specimens of *T. decandrum* in the National Herbarium.

One of these herbarium specimens collected by Standley in Honduras in 1922 bore an abundance of this same rust. Two other specimens containing the rust are also of interest from the standpoint of distribution: National Herbarium No. *2343*, E. W. Nelson, Feb. 19, 1895, Oaxaca, Mexico, and No. *19891*, P. C. Standley, Jan. 9–22, 1922, vicinity of Ahuachapan, Salvador.

6. PUCCINIA CIRCINATA (Schw.) Arth.

On *Stigmaphyllon* sp. Collected by W. A. Kellerman at Sanarata, Guatemala, Jan. 11, 1906. No. 5897.

This was a second collection of this interesting rust by Kellerman. The first one was used by Arthur (1) in describing the telial stage.

7. **Puccinia Laurifoliae** n. sp.[1] (FIG. 2)

On *Heteropteris laurifolia* (L.) Juss. Collected by W. A. Kellerman at Sanarata, Guatemala, Dec. 28, 1907. (Host determined by P. C. Standley.)

O & II. Pycnia and uredinia unknown (aecia probably not formed).

III. Telia amphigenous, scattered, round or oval, .2–.4 mm. diam., sometimes appearing larger from scattering of spores, pulverulent, epidermis rupturing in the center but not becoming

[1] This species is possibly the same as *Puccinia picturata* H. S. Jackson, The rusts of South America, Mycologia **23**: 363, No. 5, which was published since this paper was written.

conspicuous; teliospores broadly ovoid ellipsoid, flattened, 35–45 μ long by 28–33 μ wide by 17–24 μ thick, rounded at both ends, not or slightly constricted at septum; septum oblique, wall becoming chocolate-brown at maturity, uniformly 2–3 μ thick, prominently verrucose with papillae arranged in definite lines which converge from the pedicel which is near the center of one flattened side to the center of the opposite side, lines 1.5 to 2 μ apart; pedicel light cinnamon-brown, up to 50 μ long, in water

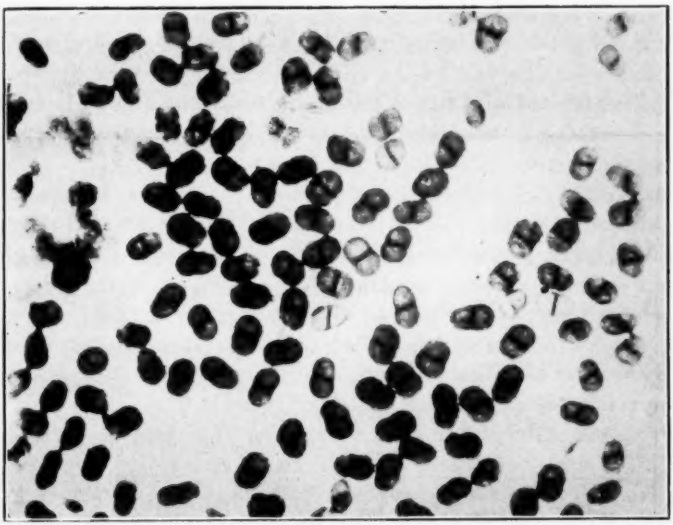


FIG. 2. Teliospores of *Puccinia Laurifoliae*. ×170. Photomicrographs by J. F. Brewer.

swelling next to spore to form a bulbous enlargement 24 μ in diameter, attached laterally.

Teliis amphigenis, sparsis, rotundis vel ovatis, parvis, .2–.4 mm. diam., pulveraceis, epidermide centro inconspicue rupta cinctis; teliosporis late ovoideis-ellipsoideis, applanatis, 35–45 μ longis, 28–33 μ latis, 17–24 μ crassis, utrinque rotundatis, septo obliquo non vel leniter constrictis; tunica in maturitate atro-brunnea, 2–3 μ aequaliter crassa, conspicue verrucosa; papillis in striis convergentibus dispositis; pedicello pallide cinnamomeo-brunneo, usque 50 μ longo, laterali, in aqua vesiculoso-inflato.

In foliis *Heteropteridis laurifoliae*, Sanarata, Guatemala.

This species differs from *P. circinata* and other closely related species by having the peculiar striate markings of the teliospores and by the pedicels being a light cinnamon-brown.

8. PUCCINIA PAULENSIS Rangel.

On *Capsicum annuum* L. Collected by W. A. Kellerman at Antigua, Guatemala, Feb. 5, 1908. Nos. *7438* and *7104*. Altitude 6,000 feet.

Aecia and telia covering large areas of stems, leaves and flowers, distorting the infected parts. (Host determined by Mr. Morton.)

The only other report of this rust is from Brazil (*9*). In fact none of the rusts of *Capsicum* have been reported outside of South America.

Averna (*2*, *3*), who also worked in Brazil, seems to have been the first to record a rust on this host. In 1913 after considerable study of the fungus on several species of *Capsicum* he described it as a new "eu-form" of *Puccinia*, *P. Capsici*. In the Guatemalan material no pycnia or uredinia have been found and it seems to be a true "*Allodus*" rust as the teliospores often form within the old aecia. However in other respects it seems to agree in general with Averna's descriptions.

Mayor (*8*) published two new species, *P. Capsici* Mayor and *P. Gonzalezi* from leaves of *Capsicum*, on which only telia were present. Spore measurements given by him do not correspond with measurements of teliospores from the Guatemalan material.

Germano de Sousa (*4*) later published the results of some observations on a *Puccinia* affecting *Capsicum* and it seems likely that he was dealing with the same species as had been described by Averna.

Recently Kern and Whetzel (*7*) described the aecial stage of what they believed to be a new rust on *Capsicum*. Their description fits very well the aecial stage of the rust on the Guatemalan material.

With the possible exception of the species described by Mayor, these rusts of *Capsicum* are no doubt closely related. However, since no specimens other than those from Guatemala are avail-

able to the writer, it is impossible to determine the degree of relationship, and even if they were, it is quite likely that no definite conclusions could be made. It does seem that *Puccinia paulensis*, as considered here, is more widely distributed than previous records of its occurrence would indicate.

J. C. Arthur has examined a part of this material and believes it to be *P. paulensis* Rangel.

9. PUCCINIA POROPHYLLI P. Henn.

On *Porophyllum* sp. Collected by W. A. Kellerman at Zacapa, Guatemala, Dec. 27, 1906. No. *6116*.

This rust has not been reported from Guatemala before and the specimen here cited is of further interest because all four rust stages are represented. The pycnial and aecial stages have not been described and no reference is found to their ever having been observed. The pycnia occur in groups 1–2.5 mm. across on both surfaces of the leaf and are dark-brown. The small delicate aecia form usually on the under surface of the leaf in a circle about the pycnia. The material is hardly sufficient for a detailed description. Additional evidence is given by the fact that a specimen of *Porophyllum nummularium* DC. in the National Herbarium (No. *1168939*) contains pycnia, aecia and telia of a rust which seems to be the same species. This latter specimen was collected at Gualan, Guatemala, by S. F. Blake, May 26, 1919.

10. PUCCINIA JALISCANA Arth.

A specimen of this rust on *Porophyllum* in the Mycological Collections of the Bureau of Plant Industry (Holway No. *5130* from Mexico) contains a few pycnia and aecia in addition to the described spore stages. In general arrangement they are quite similar to those found associated with uredinia and telia of *P. Porophylli*.

11. PUCCINIA BACCHARIDIS-MULTIFLORAE Diet. & Holw.

On *Baccharis Kellermanii* Greeman. Collected by W. A. Kellerman near Cerrito de Ori, Dept. Salada, Guatemala, Jan. 23, 1907. No. *6307*.

This is the first report of a rust occurring on this host which was named in honor of Dr. Kellerman.

12. PUCCINIA IRREGULARIS Dietel.

On *Verbesina* sp. Collected by W. A. Kellerman at Volcano Imay, Guatemala, Jan. 8, 1908.

The rust has previously been reported only from Nicaragua.

13. PUCCINIA EMILIAE P. Henn.

On *Neurolaena lobata* (L.) R. Br. Collected by W. A. Kellerman at Morales, Dept. Isabal, Guatemala, March 9, 1907, No. *6316*, and another specimen with only number and date, July 14, 1906, No. *5338*.

This is a "*Micropuccinia*" which has not been reported from Guatemala before.

14. DASYSPORA FOVEOLATA (Schw.) Berk. & Curt.

On *Xylopia* sp. Collected by W. A. Kellerman at Morales, Guatemala, March 8, 1907.

There was also an abundance of the specimen cited by Arthur (*1*).

The host was not given on either of these specimens but the teliospores are so unusual in appearance that the rust is easily recognized.

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THE CYTOLOGY OF A DIPLOID STERILE HYMENOMYCETE

J. E. Sass

(With 1 Text Figure)

In the normal nuclear cycle of a representative hymenomycete the fruiting mycelium and the fruit body, including the young hymenium, constitute the dikaryophase. During this phase the cells are binucleate, cell divisions are associated with conjugate mitoses, and at least in the vegetative mycelium clamp connections are present at the septa. The true diplophase, if we wish to make a distinction from the dikaryophase, is represented by the basidia following the fusion of the two nuclei in each basidium. Meiosis in the basidia and the subsequent formation of spores initiate the vegetative haplophase. In heterothallic species re-establishment of the dikaryophase is brought about by some form of conjugation between haploid mycelia.

Several distinct types of deviation from this generalized scheme are known. Haploid cycles which lack the binucleate and diploid condition have been described by Bauch (**1**), the present writer (**7**) and others. A number of observers have noted the occasional occurrence in nature, of sterile fruit bodies. This seems to occur in several genera of Agarics. Buller (**2**, **3**) discusses the few cases recorded in the literature, and reports on additional observations made in his laboratory. The production of sterile fruit bodies in culture, on a haploid mycelium of a heterothallic species, has been reported by Kniep (**5**) for *Schizophyllum commune* and by Hanna (**4**) for *Coprinus lagopus*. Hanna found, however, that a clamp bearing diploid mycelium of *C. lagopus* may give rise to more or less sterile fruit bodies.

The present writer has made two collections of distinctly different sterile fruit bodies. One collection consisted of a caespitose group of plants, having filiform stalks .5 mm. thick and 3 cm. long, each bearing at its apex a slight swelling which did not

develop into a pileus. Attempts to isolate this fungus in pure culture were not successful.

On a collection of horse dung incubated in the laboratory, there appeared among the usual small *Coprini* a fruit body which at first was not distinguishable from the others, but presently proved to be sterile. The stipe elongated and the cap expanded in the normal manner, but the expected blackening and deliquescence did not occur. The gills were found to be practically without spores. A culture was made by dissecting the stipe and planting minute shreds of tissue on dung extract agar. The resulting mycelium was found to have clamp connections. A culture on sterilized horse dung produced abundant crops of sterile fruit bodies like the original collection.[1] The fungus resembles *Coprinus Boudieri.*

Because of the great scarcity of spores and the viscous nature of the mature gills, attempts to isolate spores have not been successful. The fungus has been carried in culture for five years by means of vegetative transfers. Clamp connections have persisted as a feature of the mycelium, and the cultures have produced only sterile fruit bodies. The production of fruit bodies is rather erratic. No attempts have been made to analyze the effect of physiological conditions on fruiting. Occasional cultures produce abundant crops of well developed, sterile fruit bodies.

Sectors differing slightly in appearance have appeared occasionally on the mycelium on agar plates. Isolations from the sectors have yielded only clamp-bearing mycelium, which produced only sterile fruit bodies. The possibility of significant changes in the character and fertility of the mycelium arising as sectors should not be ignored.

Cytological study of the hymenium showed that the young basidia are binucleate, and that nuclear fusion occurs in the

[1] Plant 5–10 cm. high. Pileus .8–1.5 cm. high before expansion, obtuse-campanulate; when expanded umbonate-plane, 1–2 cm. across. Margin plicate, surface *slightly pruinose.* Pileus at first brownish gray, darker on disk, becoming paler until it is nearly white, except the darker disk. Stipe 1–3 mm. thick, slightly tapering upward, white, silky striate, nearly smooth. Gills distant, occasionally forked, practically sterile, in the sense that very few basidia produce spores. Spores extremely rare, *keystone shaped,* 10–12 μ $\times$ 6–8 μ, occurring in groups of 2, 3, or 4 on the basidia. After maximum expansion the fruit body collapses, but *autodigestion does not occur.* Fig. 1.

FIG. 1. The cytology of a diploid, sterile Hymenomycete.

basidia. These observations can be made with certainty, for the cells are still turgid at this stage, and good preparations can be made. As the pileus expands rapidly the gills become wrinkled, all the tissues become flaccid, and the basidia begin to collapse. It is difficult to make convincing preparations of subsequent stages. The almost complete absence of sporulating basidia reduces to the vanishing point the probability of observing their nuclear processes. Consequently, the cytology of the basidia

after karyogamy is uncertain. It is possible that most of the basidia do not develop beyond the fusion-nucleus stage.

Without single-spore cultures is cannot be stated whether this fungus is homothallic or heterothallic. Its diploid character is certain, as was shown by Hanna (**4**) to be the case in *Coprinus lagopus*. The remarkable viability of the culture and the constancy of the sterile character indicate that sterility is not necessarily caused, as Buller (**3**) suggested, by nutritional deficiencies. In view of the apparent failure of meiosis in the basidia, it is more probable that sterility is the result of this nuclear aberration. This situation is comparable to the failure of pollen formation in vegetatively normal, diploid flowering plants.

In view of our present knowledge of the cytology and sex reactions of haploid sterile and diploid sterile fruit bodies, it would be desirable to make further analyses of the reactions between haploid mycelia derived from haploid sterile, diploid sterile, and normal diploid fertile fruit bodies. The identity of the present fungus is too uncertain, and the degree of sterility too high to make further study profitable. The known occurrence of sterility in other genera of agarics affords attractive possibilities of further cytological and genetical studies on sterility.

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PROMINENCE OF A CONIDIAL STAGE IN PATELLA ABUNDANS [1]

A. G. KEVORKIAN

(WITH 1 TEXT FIGURE)

INTRODUCTION

In the family Pezizaceae conidial stages have been observed only rarely and within the many known genera have been reported only in *Aleuria* (**7**), *Pustularia* (**1**), *Plicaria* (**1**), *Peziza* (**1**), and *Pyronema* (**6**). Those produced in these genera alike bore hyaline ovoid conidia, on short sterigmata in heads characteristic of the *Oedocephalum* type of the imperfect fungi. In the genus *Patella*, however, in contrast to the preceding a *Botrytis* type of conidial fructification occurring on a variety of substrata in the vicinity of New York City has been reported for *Lachnea* (*Patella*) *abundans* by B. O. Dodge (**2**). Moreover, Gwynne-Vaughan and Williamson in London reported *Lachnea* (*Patella*) *cretea* (**3**), which has a similar conidial stage and indeed is considered as a synonym under *Lachnea* (*Patella*) *abundans* by Seaver. The writer, furthermore, has secured from a culture of horse dung from China a fungus identified by B. O. Dodge as *Lachnea* (*Patella*) *abundans* (Karst.) Sacc., and also a similar fungus in Rhode Island from a culture of a burnt stump. Both of these regularly produced a *Botrytis*-like conidial phase in abundance.

The fact that wherever this fungus has been reported, whether from New York, London, China, or Rhode Island, the typical *Botrytis* conidial stage has been found invariably to occur, would seem to indicate that this is a permanent phase and not a transient one induced by special nutrient and climatic conditions. It is the purpose of this paper, therefore, to present evidence supporting this view.

[1] Although *Lachnea* is the more widely known and universally used generic name, the writer prefers to use *Patella abundans* (Karst.) Seaver,[4] since *Lachnea* is in use as a valid genus of flowering plants and according to Article 65 of the International Code it is invalid as a cryptogamic genus.

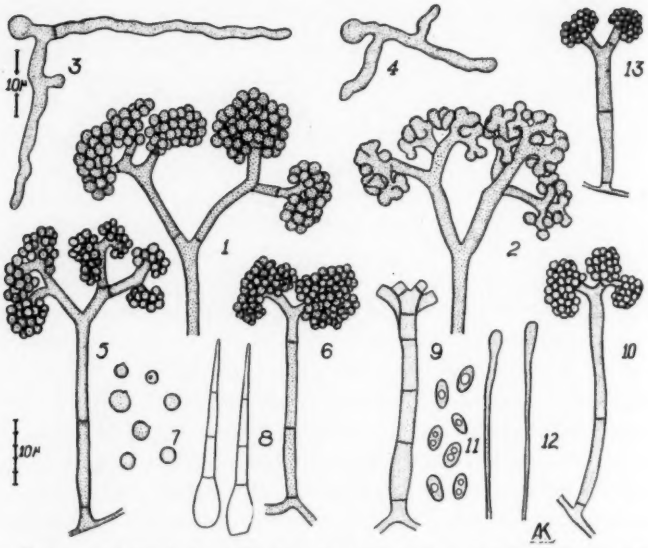

FIG. 1. (1) Typical conidiophore bearing clusters of *Botrytis*-like conidia on dichotomously branched conidiophores from material of the Chinese strain grown on 2 per cent potato dextrose agar (× 200); (2) Similar conidiophore, showing knob-like terminal enlargements before the development of conidia therefrom. Material from China grown on dung decoction agar (× 200); (3, 4) Two conidia from China strain germinating readily in sterilized tap water by means of thick branched germ tubes (× 350); (5) Conidiophore of China strain showing only slightly stunted habit, resulting from growth on tobacco (× 200); (6) Conidiophore of China strain showing stunted, sparsely branched condition typical of growth on tobacco (× 200); (7) Typical conidia, showing variation in size and shape, and the presence on same of a perceptible papilla of attachment. (× 350); (8) Setae, showing typical tapering form, bulbous base, and 3 septations (× 350); (9) Large conidiophore of the Rhode Island strain grown on tobacco showing the loss of the typical knob-shaped ends after the conidia have been scattered and the persistence of bases of secondary branches (× 200); (10) Conidiophore of Rhode Island strain grown on tobacco, partly matured, showing stunted, slightly branched habit typical of growth on this substratum (× 200); (11) Ascospores showing variation in size and shape and in number and position of oil droplets within the granular content (× 350); (12) Paraphyses, showing the typical swollen ends (× 350); (13) Very stunted conidiophore bearing few conidia. Rhode Island strain grown on tobacco (× 200). The drawings were made with the aid of a camera lucida, living material being mounted in Lacto-phenol-Carbol fuchsin, allowed to regain turgidity and then drawn. The magnifications apply to the present figures which have been reduced to approximately 1/3 diameter in reproduction. Scales in microns are included also for more accurate measurements.

TYPICAL LIFE HISTORY

Both of these fungi, one isolated from horse dung from China, and the other developing on a burnt stump in Rhode Island, run through a life cycle comprising a *Botrytis*-like conidial stage followed by an apothecial stage which is typical of *Patella abundans*.

The conidia of these two forms, within 48 hours after planting, usually develop in *Botrytis*-like clusters (FIG. 1) on knob-like globular ends (FIG. 2) of branched conidiophores which in the China form are almost perfectly dichotomous and in the Rhode Island form are less so. At maturity the conidia (FIG. 7) are spherical to obovate, 7 to 9 μ in diameter, smooth, and with a papilla at the point of attachment.

The ascocarps of both organisms are discoid, slightly buff colored and about 1 to 3 mm. in diameter. The ascospores (FIG. 11) are 6 to 8 $\times$ 12 to 16 μ, fusoid, 1 to 2 guttulate; borne uniseriately 8 in an ascus of about 150 μ in length. The paraphyses (FIG. 12) are about 150 μ long, enlarging abruptly at the ends to 4 to 5 μ. The hairs (FIG. 8) surrounding the ascocarp are buff to pale brown, several septate, tapering to a point.

It is evident that both forms are homothallic, for a single conidium, or a single ascospore may give rise to conidia and apothecia in each case.

CULTURAL STUDIES

As Seaver (**5**) has enumerated a list of the substrata upon which the genus *Patella* has been reported, these were tested in order to determine the cultural requirements of the two fungi and to ascertain the presence or absence of conidial development under such conditions.

Table I gives in brief form the kinds of agars or substrata used, the type of spores sown, and the kind of growth and sporulation of the two organisms which resulted.

An examination of this table brings out certain points of interest. The conidial phase, for example, of both strains was always present on all media and substrata tried, showing that it is not an occasional but typical part of the life cycle, whereas the development of the ascogenous phase seemed to require special richly nutrient media such as oatmeal and potato-dextrose, its develop-

TABLE I

Substratum	Material Sown	Method of Growth	
		China Strain	Rhode Island Strain
Malt Agar	Conidia	Aerial mycelium and conidia very abundant growing on agar. Only one apothecium observed.	Aerial mycelium and conidia abundant, growing on agar and on sides of tube. Only a few apothecia observed.
Malt Agar	Ascospores	Aerial mycelium scarce, conidia very abundant, numerous apothecia, growth along edges of agar.	Aerial mycelium very scarce. Conidia very abundant. Apothecia produced in great abundance. Growth along side of tube.
Malt Agar	Abortive growth (conidia and hyphae)	Aerial mycelium in abundance. Conidia fairly abundant. Apothecia very small and scarce.	Aerial mycelium in abundance. Conidia abundant. No apothecia observed.
Malt Agar	Abortive growth	Aerial mycelium very scarce. Conidia abundant. Apothecia small but abundant.	Aerial mycelium very scarce. Conidia abundant. Apothecia small but abundant.
Oatmeal Agar	Ascospores	Aerial mycelium lacking. Conidia and apothecia produced on tube. Aborted apothecia produced on agar.	Aerial mycelium slight. Conidial and apothecial growth fair. Hyphal and conidial mass produced in a clump. No aborted apothecia observed.
Potato Dextrose Agar	Conidia	Aerial mycelium scarce. Conidia and apothecia rather scarce, produced on glass. Abortive apothecia on agar.	Aerial mycelium very abundant, conidia scarce. Apothecia none. Growth on agar.
Potato-plaster [1] Agar	Conidia	Aerial mycelium very scarce. Conidia formed on surface of agar. No apothecia formed.	Aerial mycelium very scarce. Conidia formed on surface of agar. No apothecia formed.
Soil	Conidia	Aerial mycelium scarce, conidia rather scarce, produced on surface of soil and on sides of flask. Apothecia scarce.	Aerial mycelium scarce. Conidia very scarce. Apothecia more abundant than in China strain.
Cinders [2]	Conidia	Aerial mycelium scarce, conidia very scarce. Only two apothecia found.	Aerial mycelium scarce. Conidia very scarce. No apothecia observed.

[1] Small clumps of ceiling plaster added to ordinary potato agar.
[2] Furnace cinders, sterilized.

[1] Small clumps of ceiling plaster added to ordinary potato agar.
[2] Furnace cinders, sterilized.

TABLE I—*Continued*

Substratum	Material Sown	Method of Growth	
		China Strain	Rhode Island Strain
Clumps of Plaster	Conidia	Aerial mycelium slight. Conidia very abundant on surface of substrate. No apothecia observed even after two months.	Aerial mycelium scarce. Conidia fairly abundant. No apothecia observed even after two months.
Dried Autumn Leaves	Conidia	Aerial mycelium in abundance. Conidia very abundant. Numerous apothecia.	Aerial mycelium in abundance. Conidia very abundant. Apothecia scarce.
Paper	Apothecium	Aerial mycelium in abundance. Conidia abundant. Numerous apothecia.	Aerial mycelium in abundance. Conidia scarce. Two apothecia observed.
Decayed Wood	Conidia	Aerial mycelium rather abundant. Conidia very scarce. No apothecia observed.	Aerial mycelium in abundance. Conidia scarce. No apothecia observed.
Ashes	Apothecium	Aerial mycelium fairly abundant. Conidia produced abundantly. Appearing grayish in mass instead of the typical pale buff color on agar. No apothecia observed.	Aerial mycelium fairly abundant. Conidia produced abundantly. Appearing grayish in mass instead of the typical pale buff color on agar. No apothecia observed.
Tobacco [3]	Apothecium	Aerial mycelium in abundance. Conidia very abundant, with short, thick conidiophores, usually not branched as much as those on agar. Abortive apothecia that do not mature, observed.	Aerial mycelium in abundance. Conidia very abundant, with short, thick conidiophores, usually not branched as much as those on agar. Abortive apothecia that do not mature, observed.
Potato Dextrose Agar	Conidia from Tobacco Culture	Aerial mycelium in abundance. Conidia scarce. Apothecia abundant, some twice as large and lighter in color than others.	Aerial mycelium in abundance. Conidia scarce, produced on glass. Apothecia abundant and normal, produced on glass and agar.

[3] Cigarette tobacco, sterilized.

ment being inhibited on such non-nutrient or scanty nutrient substrata as plaster, wood, ashes and tobacco. Another point of interest is the fact that two fungi from such widely different sources, in general grew in the same manner. Moreover, the appearance of conidia and ascocarps of the China organism always preceded that of the Rhode Island strain by 2 to 8 days on each substratum, showing its characteristically more rapid development.

Since the cultural differences are slight, as has been noted above, it seemed desirable next to compare the spore measurements of the two fungi. In Table II the sizes of spores grown on potato dextrose agar under approximately identical conditions, and mounted in Amann's Medium in the same way, were compared for the two fungi.

TABLE II

COMPARATIVE SPORE MEASUREMENTS

Ascospores Length Classes in Microns	China Strain No. of Spores in 100	Rhode Island Strain No. of Spores in 100
10–11.9 μ	5	1
12–13.9 μ	77	47
14–15.9 μ	17	49
16–17.9 μ	1	3
Width Classes in Microns		
4–5.9 μ	3	0
6–7.9 μ	75	33
8–9.9 μ	22	67
Conidia Diameter Classes in Microns		
6–6.9 μ	10	18
7–7.9 μ	48	45
8–8.9 μ	37	32
9–9.9 μ	0	5
10–10.9 μ	5	0

It is obvious that in respect to size of spores there is little, if any, difference between the two organisms. Since the kind of growth and sporulation are so similar, and since the two forms are homothallic, a single ascospore or conidium giving rise to ascocarps, the writer is inclined to believe that the two are different strains of the same species.

It is of interest therefore that the two fungi derived from such widely separated localities as China and Rhode Island alike

should develop a well defined *Botrytis*-like conidial phase with such persistence and regularity.

The writer takes pleasure in acknowledging his indebtedness to Prof. W. H. Weston Jr., at whose suggestion this research was undertaken, for the helpful criticism during the investigation and also for the material from China.

SUMMARY

1. The development in culture, the method of growth, and sizes of the spores of two similar forms of *Patella abundans*, one derived from China, the other from Rhode Island, were compared and found to be practically identical.

2. This species therefore is inferred to be of wider distribution than has been supposed.

3. A *Botrytis*-like conidial stage is a definite, persistent, well defined characteristic developmental phase in the life history of this organism. This augments and corroborates the findings of B. O. Dodge in the case of this species in New York.

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LABORATORIES OF CRYPTOGAMIC BOTANY,
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NEW FUNGI FROM ISLE ROYALE

ALFRED H. W. POVAH

(WITH 2 TEXT FIGURES)

During the summer of 1930 the writer spent three months on Isle Royale in Lake Superior as a member of the Botanical Party of the Survey of Isle Royale conducted by the State of Michigan under the auspices of the University of Michigan. The complete list of species is to be published later. In a collection of fungi numbering approximately eleven hundred collections the following fungi are believed to be undescribed. The specimens have been deposited in the University of Michigan Herbarium, with duplicates in the author's herbarium.

Patella michiganensis sp. nov.

Apothecia gregarious, ochraceous-orange to cinnamon (R.), 0.3–0.7 mm. in diameter; clothed with simple, septate, brown hairs, 300–900 × 30–50 μ, those hairs near the margin of the apothecium with an enlarged and often forked base, those hairs lower down on the apothecium with a tapering base; asci cylindrical 180–200 × 9–10 μ, not staining blue with iodine, 8-spored; spores uniseriate, smooth, hyaline, elliptical, 13.5–15.5 × 8.5–9 μ; paraphyses slender, clavate at the tip where the diameter is 5.5 μ.

Apothecia gregaria, aurantia vel cinnamomea, 0.3–0.7 mm. diam., septatis fulvisve setis vestita 300–900 × 30–50 μ, eis margine dilatatis et saepe furcatis ad basem, eis inferioris simplicibus et non dilatatis. Asci cylindracei 180–200 × 9–10 μ, 8-spori. J—. Sporae leves, hyalinae, ellipsoideae, 13.5–15.5 × 8.5–9 μ, monostichae. Paraphyses filiformes, apice clavatae 5.5 μ cr.

Collected on July 16, 1930, by A. H. Povah on moose dung at Moose Lake, Tobin Harbor, Isle Royale, Michigan. No. Fp *211*. Type in the University of Michigan Herbarium with duplicate in the author's herbarium.

This species differs from *Patella maculosa* (Phill.) Seaver in not

having brown spots on the apothecium; in possessing stiff, sharp-pointed hairs, rather than flexuous, blunt hairs; in the somewhat larger spores and the paraphyses being swollen at the tip.

The species was also collected on the Sargent Lake Trail, McCargoe Cove and at Tobin Harbor by J. L. Lowe and A. H. Povah.

Erinella borealis sp. nov.

Apothecia gregarious, 0.3–0.7 mm. in diameter, short-stipitate, hymenium buff yellow (R.), externally white and covered with delicate, hyaline hairs; asci clavate 98–105 × 8–8.5 μ, 8-spored;

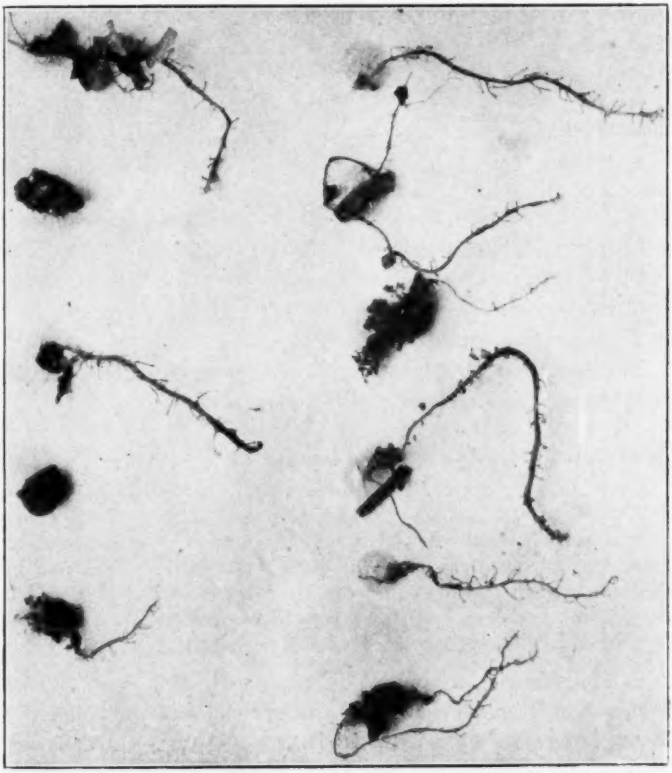

FIG. 1. Portion of type collection of *Sclerostilbum septentrionale* (× 2.5), showing sclerotia with racemosely branched coremia attached.

spores fasciculate, filiform-fusiform, somewhat sigmoid, hyaline, 33–58 × 1.5–2 μ, becoming triseptate; paraphyses filiform, 1 μ in diameter, but slightly enlarged at the apex.

Apothecia gregaria, aurantia vel cinnamomea, 0.3–0.7 mm. diam., brevi-stipitata, disco luteo, extus albis pilis vestita. Asci clavati 98–105 × 8–8.5 μ, 8-spori. Sporae filiformes-fusiformes, rectae vel subcurvatae, 3-septatae, hyalinae, 33–58 × 1.5–2 μ, fasciculatae. Paraphyses filiformes, 1 μ cr. apice minimum latior.

Collected August 14, 1930, on dead stems of *Chamaedaphne calyculata* in swamp of *Thuja occidentalis*, Rock Harbor, Isle Royale, Michigan, by A. H. Povah. No. Fp *497*. Type in the University of Michigan Herbarium with duplicate in the author's herbarium.

Sclerostilbum gen. nov.

Coremium arising from a sclerotium, with a sterile central axis; lateral branches usually terminating in a depressed-globose head bearing conidia; conidiophores branched; conidia in chains.

Coremiis racemis, ex sclerotio, sterile apice, ramis lateralibus semper ferme cum subgloboso capitulo conidia ferenti; conidiophoris ramificatis; conidiis in catenis.

Type species, *Sclerostilbum septentrionale*.

The genus resembles *Stilbothamium* superficially but differs in the presence of a sclerotium and catenulate spores.

Sclerostilbum septentrionale sp. nov. (FIGS. 1, 2.)

Coremium 6–35 mm. tall, arising from a brownish-black sclerotium, central axis 200–500 μ in diameter, bearing 30–50 short lateral branches and thus forming a raceme; central axis ending in a sterile tip, lateral branches 0.5–2 mm. long, 100–250 μ in diameter, usually ending in a depressed-globose head 125–370 μ broad, but occasionally sterile; conidiophores branched; conidia in chains, hyaline, elliptical, 7–12.5 × 4–5.5 μ.

Coremiis 6–35 mm. longis, 200–500 μ crassis, ex sclerotio, 30–50 brevivus, lateralibus ramis in racemo; medio axe apice sterile; lateralibus ramis 0.5–2 mm. longis, 100–250 μ cr. semper ferme cum subglobosa capitulo 125–370 μ crasso; conidiophoriis ramificatis; conidiis ellipticis, 7–12.5 × 4–5.5 μ, hyalinis, catenulatis.

Collected on September 7, 1930, among decaying leaves beside brook forming outlet to Chickenbone Lake, McCargoe Cove, Isle Royale, Michigan, by A. H. Povah. No. Fp *440*. Type in the University of Michigan Herbarium with duplicate in the author's herbarium.

That the present fungus may be the imperfect stage of a species of *Xylaria* is suggested by Moeller's [1] illustration. The writer

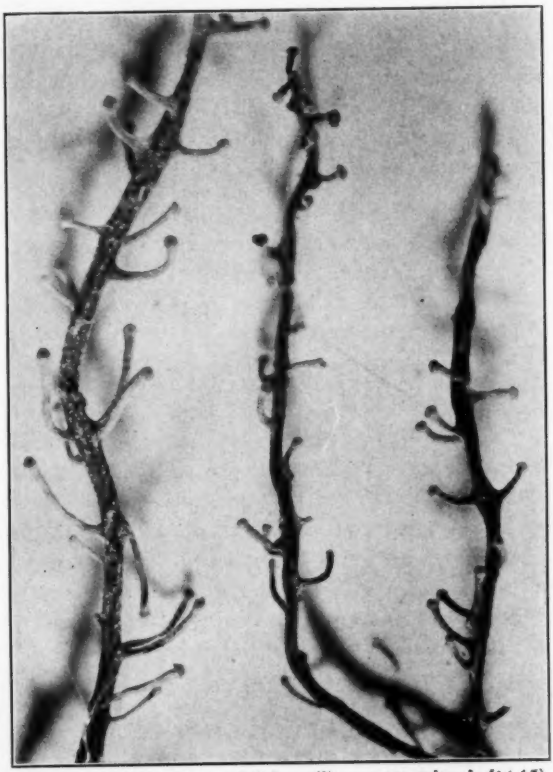

Fig. 2. Portion of type of *Sclerostilbum septentrionale* (× 15).

is indebted to Dr. Thaxter for showing him an undescribed species of *Xylaria* arising from a sclerotium which he collected in Maine.

[1] Moeller, Alfred, 1901. Phycomyceten und Ascomyceten. Untersuchungen aus Brasilien. Jena. p. 244.

Septoria Calypsonis sp. nov.

Pycnidia gregarious, on the upper surface of the leaves, minute, black, 82–115 μ in diameter, located in blackened areas 4–5 mm. in diameter or through confluence larger; spores filiform, hyaline, straight or curved, continuous, 28–48 $\times$ 0.75–1.0 μ; conidiophores short, unbranched.

Pycnidia gregaria, in foliorium superficie, minuta, atra, 82–115 μ diam., areia atris vel 4–5 mm. diam. vel confluentia maioribus disposita; sporidiis filiformibus, hyalinis, rectis curvatisve, continuatis, 28–48 $\times$ 0.75–1 μ; sporophoris brevis, simplicibus.

Parasitic on the leaves of *Calypso bulbosa*, Smithwick Island near Isle Royale, Michigan. Collected July 1, 1930. A. H. Povah. No. Fp *50*. Type in the University of Michigan Herbarium with duplicate in the author's herbarium.

DETROIT, MICHIGAN

NOTES AND BRIEF ARTICLES

Volume 7, Part 13 of North American Flora consisting of a host index of the Uredinales published in North American Flora was issued on December 30, 1931. This will be welcome to mycologists since it will make the volume much more usable.

An oil portrait of Dr. J. C. Arthur was unveiled in the Agricultural Experiment Station of Purdue University, Lafayette, Indiana, on Wednesday, October 7, with a brief address by one of his former students, Dr. D. T. MacDougal, of the Desert Laboratory, Tucson, Arizona. Dr. Arthur, now in his 82nd year, is actively engaged in preparing a manual of the rusts of the United States and Canada.—M. W. GARDNER.

STUDIES ON THE GENUS PYTHIUM

In this book by Velma Dare Matthews an attempt is made to give descriptions to all the species of *Pythium* which had been discovered at the time of publication, and to report on twenty species which have been isolated by the writer. Of these, five are considered new. Keys are given to the genera of the family Pythiaceae and to the species of the genus *Pythium*. Several species are reported from the United States for the first time. There are twenty-nine plates. Twenty-six of these are from original drawings and three are copied from illustrations of species which the writer has not seen. There are 134 pages in all, nineteen of which are devoted to a bibliography. Published by The University of North Carolina Press. Price $3.00 postpaid.

SPERMOGONIA OF DIPLOCARPON ROSAE

In discussing the life history of the rose black spot fungus in a recent paper (Mycologia *23*: 446–462. 1931) I stated that no one had previously mentioned that this fungus produces spermo-

gonia. This was an oversight on my part as I now find that Dr. F. A. Wolf had already discovered these structures and mentioned them in his paper on "Leaf Scorch Disease of Strawberries" (North Carolina Agr. Exp. Station Tech. Bull. 28, 1926) where he points out that in their morphology and life history the strawberry leaf scorch fungus and the rose black spot fungus are very much alike. He has given several figures in support of his view. Spermogonia were very abundant on infected rose leaves which were still green in November in our rose garden.—B. O. DODGE.

LABOULBENIACEAE

Part 5 of Dr. Roland Thaxter's work "Contribution towards a monograph of the Laboulbeniaceae" has recently been received. This is published as a Memoir of The American Academy of Arts and Sciences (Volume 16, Part 1). It was originally intended to include in this part all the forms published or assembled since the appearance of Parts 1 and 2 but it has been found necessary by Dr. Thaxter to leave out the largest genus *Laboulbenia*, which he hopes to publish at some later time. The present volume consists of 375 pages with 60 plates and 1136 figures. It considers 90 genera, many of them new, and is a continuation of Part IV of this series of Memoirs (Am. Acad. Vol. 15, pp. 430–580, Plates 1–24) in which 12 genera are considered including more than a hundred species of the very varied and remarkable genus *Rickia*. The plates are artistically done in his characteristic, careful and painstaking manner. The whole work is a most valuable contribution to our knowledge of the subject. It is to be hoped that Dr. Thaxter may finally complete the last part of this work.

THE WINTER MEETING

The meeting of the Mycological Section of the Botanical Society of America held in New Orleans during the winter was well attended in spire of the fact that it was far from the center of the main mycological activities of the country. One session was arranged for mycological papers. The program, however, was overcrowded and might easily have furnished material for two sessions. The papers were interesting, but the time was too

brief for adequate discussion. One joint session was then held with the Phytopathological Society.

The most important transaction of the Mycological Section was the decision to establish an independent mycological society. Dr. William H. Weston Jr. of Harvard was appointed President and Dr. H. M. Fitzpatrick of Cornell Secretary. A committee of five, including the two officers, was appointed to draw up constitution and by-laws, arrange for summer forays, and consider the question of mycological publication, the committee to report at the first regular meeting to be held in Atlantic City in connection with the American Association for the Advancement of Science.

NEW YORK MYCOLOGICAL SOCIETY

During the summer of 1931 the New York Mycological Society was reorganized with Dr. William S. Thomas, author of "Common Gilled Mushrooms," as President and Miss Margaret McKenny, author of "Mushrooms of Field and Wood," as Secretary. On October 26th, the newly formed Society in collaboration with the Torrey Botanical Club and The New York Botanical Garden gave a luncheon in the American Museum of Natural History in honor of Dr. Jakob E. Lange, the Danish expert on gill fungi, who had been spending the summer in the United States. Preceding the luncheon Dr. Lange made an exhibit of several hundred watercolored drawings of European gill-fungi. This exhibit was supplemented by a display of fresh material a study of which furnished for the local students of fungi a mycological "love feast." The meeting was attended by most of the local mycologists connected with the various institutions in and about New York City. Among the distinguished visitors from out of town was Mrs. Eliza Blackford, President of the Boston Mycological Club, an artist naturalist whose inspiring personality and unceasing efforts have kept the Boston organization in a flourishing condition for many years.

THE C. G. LLOYD MYCOLOGICAL COLLECTION

The mycological collection of the late C. G. Lloyd of Cincinnati was donated by the trustees of the Lloyd Library and Museum

to the Smithsonian Institution and transferred to Washington where it was placed in the custody of the Bureau of Plant Industry. The collection totals nearly 60,000 specimens of fungi, 12,000 negatives, a considerable series of prepared slides, Mr. Lloyd's correspondence in part, his notebooks and various miscellaneous items. The fungi have been catalogued, relabelled and arranged so that the Lloyd Herbarium is now in working order. A complete alphabetical index has also been prepared. Under the terms of the agreement covering the transfer to the Smithsonian Institution, the specimens constituting the collection can not be sent out of Washington but are available for study by interested mycologists in the Division of Mycology and Disease Survey, of the Bureau of Plant Industry.

Among the materials in the collection are a number of sets of the photogravures of American fungi originally issued by Mr. Lloyd about thirty years ago. These sets as now constituted contain the original 26 numbers with the addition of six plates prepared by Mr. Lloyd but never distributed. These sets are offered as long as the supply lasts to Mycological herbaria or Botanical Institutions. The plates are sent out under the names used by Mr. Lloyd. Some of the numbers, including the six not previously issued, can also be supplied separately to permit the filling out of incomplete sets.

An index to Volume 7 of the Mycological Writings of C. G. Lloyd has been prepared by the custodian of the collection and published by the Lloyd Library. Copies will be sent on request. —JOHN A. STEVENSON.

THE GENERA OF FUNGI [1]

Interest, perhaps not unmixed with surprise, has doubtless greeted the recent appearance of "The Genera of Fungi" which seems to be a revision of the former work published by Clements in 1909 and largely a translation of Saccardo's keys, the new work being somewhat augmented and embellished with illustrations. While this is a tremendous undertaking and perhaps too "Herculean" a task to be satisfactorily executed by any one or any

[1] Frederick E. Clements and Cornelius L. Shear. The Genera of the Fungi. I–IV, 1–496, pls. 1–58. The H. W. Wilson Co., New York. 1931. Price $8.00.

two men, however well versed in mycology, it is nevertheless difficult to account for the flagrant errors and incongruities with which the work literally abounds. The comments, however, which the writer has to make will be confined largely to the Pezizales and Hypocreales, on which he has done special work. It is hoped that the authors have been more successful in their disposition of the genera of other groups.

The treatment of the genera of the cup-fungi is to say the least a disappointment. In the first place the authors refuse to recognize the segregation of the cup-fungi into the inoperculates and operculates, since as stated by them "*it is considered to make an unnatural division of the phylum.*" Consequently they follow the old tradition, keeping the operculate Helvellae and inoperculate Geoglossae in the same family Helvellaceae, in the diagnosis of which they state (page 139) in referring to the asci "*opening by an operculum,*" apparently oblivious of the fact that the asci in more than half of the species of the genera included in the family by them **do not open in this manner at all** but are inoperculate.

Contrary to their statement, the division into the operculates and inoperculates is one feature in our classification of the cup-fungi which follows absolutely natural lines, whatever may be said for subsequent subdivisions, and is so regarded at the present time universally by morphologists and taxonomists of the group, so far as the writer is aware.[2] It would be just as logical to argue that the "monocots" should not be separated from the "dicots," regardless of their anatomical differences, since such a division would be unnatural in that it separates the palm trees from other trees which they remotely resemble in size and form. Having lightly ignored the fundamental basis of classification in cup-fungi we can scarcely expect a satisfactory treatment of the subordinate groups, and in fact the whole group becomes another "mycological omelet."

The characters on which the families of the cup-fungi are based are at best vague and unsatisfactory and in the main the authors have followed the usual procedure, except that the lichen genera have been interspersed with those of the other fungi which is in

[2] See Gäumann, E. A. and Dodge, C. W. Comparative Morphology of Fungi, p. 317, 1928.

line with the modern trend. Some of the families, however, of the non-algicolus cup-fungi are open to question. The authors persist in segregating the Ascobolaceae from the Pezizaceae on the fimicolous habitat and the exsertion of the ascus, notwithstanding the fact that the latter has long been known to be absolutely worthless as a diagnostic character. The exsertion of the ascus is common in many species of the Pezizaceae and especially conspicuous in the genus *Lamprospora* (MYCOLOGIA **4**: 47. 1912). The fimicolous habitat would be a convenient character on which to separate the Ascobolaceae were it not for the fact that a number of species of the genus *Ascobolus* reported from North America (7 out of 16 to be exact) are non-fimicole. It will be seen, therefore, that the characters used in segregating the Ascobolaceae are absolutely unreliable and the family cannot stand. While the other families in the main follow general usage one is frequently surprised to find familiar genera in the wrong family. One of these departures will be cited as an illustration.

The family Ascobolaceae which, as stated above, cannot be maintained on the characters used, is divided by the authors into two subfamilies based on the color of the spores, the Ascophanae with colorless spores and the Ascobolae with colored. They then follow Lindau (*E. & P. Nat. Pfl.* 1^1: 191. 1897), in retaining the genus *Boudiera* in the violet spored section of the Ascobolaceae notwithstanding the fact that **the spores are never violet; plants non-fimicolous; neither do they have exserted asci** (so far as observed). In fact the genus has none of the characters which would qualify it for the family or subfamily in which it is placed by them. Unfortunately Lindau erroneously described the genus as having violet spores. The species from which Lindau's description was drawn was apparently not a *Boudiera* but possibly an *Ascodesmis*, since the two genera were confused by Lindau. The perpetuation of these errors is again inexcusable since all of the data have been published (MYCOLOGIA **6**: 107. 1914), and the observations based not only on authentic material from Europe but on fresh material collected by the writer in Iowa. So far as known the genus has been found from only two localities in North America, and belongs with the Pezizaceae.

GENERIC TYPES

One of the novel features of this work is the designating of the type species for all the recognized genera of the fungi. Perhaps the most novel thing of all is the easy method by which this is accomplished. To use the exact words of the authors "*the type species should be chosen from the best known or more important species generally included in the genus at present*," which apparently means the species best known to the authors of this book. If they knew but one species in the genus that species would become the type regardless of the fact that the type may have been otherwise indicated not only by the author of the genus but by subsequent "revisionists." To use the authors' words again,—"*this in many cases necessitates the choice of a species not included by the original author of the genus.*" All this is done on the pretext of securing stability of nomenclature but in looking over this work we find that after reviling the "revisionists" for inaugurating changes on the basis of priority these "advocates of stability" at any cost proceed to beat the "revisionists" at their own game, ruthlessly overturning genera without the slightest regard to either priority or usage, unless their own work should be regarded as the "last word" in usage. Not only is this procedure inconsistent with the principles which they themselves advocate but it is absolutely contrary to the rules adopted at the last International Congress which The New York Botanical Garden now proposes to follow and which read as follows: (translated from the French) "XVIII quater. *When one makes a revision of a genus he shall indicate carefully the species which he accepts as the standard or nomenclatorial type.*" "Note. —*The type species* **is the original species** *or one of the original species on which the genus was based, the standard species is* **one of the original species** *other than the type, which permits the conservation of the generic name in its current application.*" In no case do these rules justify the selection as the type of the genus a species not originally included in it by its author although it does allow one to select some species other than the first one mentioned if by so doing we may preserve the present concept of the genus. A few illustrations will be cited from the Pezizales and Hypocreales in order to bring out the illegality and inconsistencies in the authors' method of procedure:

1. In looking over the genera of the Pezizaceae in Clements and Shear one will note that the genus *Discina* Fries is typified by the species *Peziza venosa* Pers. Now, when this genus was founded by Fries (*Summa Veg. Scand.*, 348. 1849), he based it on the species, *Discina perlata* Fries, characterized by its apiculate spores. When Saccardo took up this genus (*Syll. Fung.* **8**: 99. 1889) the same species was mentioned first and therefore regarded as typical. When the writer monographed the genus in 1928 he followed the previous authors in using the same type. **Does this or does this not constitute general usage?** The authors apparently think not since they choose to disregard all this and select *Peziza venosa* as the type, a species not originally included in the genus and one not now nor then regarded as congeneric with Fries' type and which if accepted (of course it will not be) would make it a straight synonym of *Peziza* and necessitate a new name for those forms now placed in *Discina*.

2. Another example from the Pezizaceae might well be cited to illustrate Clements and Shear's method of stabilizing the nomenclature of the cup-fungi. It has long been known that the name *Lachnea* is untenable [3] as a generic name in the cup-fungi since it had previously been used for a genus of flowering plants. **On this point the authors and writer are agreed.** The writer, recognizing this fact, reluctantly replaced the old name *Lachnea* with and prior name *Patella* of Weber and transferred all the members of this genus to that name (*North American Cup-fungi*, 156. 1928). This name was selected in accordance with the rules of the American Code of Nomenclature, which rules the authors of this book helped to formulate. The authors of the new work, however, through oversight or otherwise, have failed to accept the substitution of this name but have preferred to adopt instead the later name *Scutellinia*, first used by Cooke as a subgenus and later raised to generic rank by Otto Kuntze but erroneously assigned to Cooke by Clements and Shear. This

[3] International Code, Art. 65 (vide former Art. 27, 29, 51: 20, 53). "A name of a taxonomic group is illegitimate and must be rejected if it is a later homonym, that is if it duplicates a name previously and validly published for a group of the same rank based on a different type. Even if the earlier homonym is illegitimate, or is generally treated as a synonym on taxonomic grounds, the later homonym must be rejected."

name is not tenable under either the American or the International Code of Nomenclature. If their suggestion is followed it will necessitate another overturning of the genus *Patella* and a new set of combinations for more than half the species of the genus. Furthermore, since *Lachnea* cannot be retained as a generic name in the fungi to select *Scutellinia* instead of the prior name *Patella* is neither in accordance with the rule of priority nor their own suggestions (page 16) "*that each name proposed be short, significant, euphonious*," etc. Since *Patella* is not even cited as a synonym, the writer would be inclined to regard this as an oversight, were it not for the fact that the work in which this appears is cited in their bibliography. If on the other hand they chose to ignore these facts, the writer has a perfect right to charge them with insincerity in their feigned efforts to cooperate in stabilizing the nomenclature of the cup-fungi for they have, after again disregarding both priority and usage, committed the very offense with which they so often charge the "revisionists."

3. Still another illustration might be drawn from the cup-fungi. The genus *Bulgaria* was established by Fries (*Syst. Myc.* **2**: 166. 1822) and two widely known species included in the genus. The first of these was *Bulgaria globosa*, a terricolous species with an operculate ascus and hyaline spores. The other, *Bulgaria inquinans*, is a lignicolous species with inoperculate ascus and brown spores. For some time it has been known that these species are not congeneric and efforts have been made to separate them, but so far as general usage is concerned both have continued to be recognized as *Bulgaria* (*Sacc. Syll. Fung.* **8**: 636–637. 1889). Since the former is one of the operculates it was treated by the writer (*North American Cup-fungi*, 194. 1928) under the name *Bulgaria* with *Sarcosoma* Casp. as a synonym. *Bulgaria globosa* was designated the type of the genus.

The writer in his forthcoming monograph is then proposing the name **Phaeobulgaria** nom. nov. with *Peziza polymorpha* Oeder (*Peziza inquinans* Pers.) as the type, which is to be used for the lignicolous brown spored inoperculate species which, in the opinion of the writer, belongs with the Dermateaceae. Clements and Shear as usual disregard this treatment and reverse the situation making *Peziza inquinans* the type of the genus *Bulgaria*.

In this case there is less confusion since so few species are involved but inasmuch as the genus had already been monographed and the type designated in accordance with the rules of the International Code it should be allowed to stand unless valid reasons, other than mere personal preference, can be advanced for reversing this decision.

4. One of the most interesting cases of "sleight of hand" work in the selection of types is to be found in the case of *Lachnella* (page 327). This genus was established by Fries (*Summa Veg. Scand.*, 365. 1849) and six species enumerated. Boudier found that the sixth species was an operculate and not congeneric with the other five mentioned by Fries all of which are inoperculates. He therefore made this the type of a new genus *Perrotia* (*Bull. Soc. Myc. Fr.* **17**: 24. 1901). This genus has been recognized as valid by students of cup-fungi and has already been treated among the operculates (*North American Cup-fungi* 154. 1928). That Clements and Shear should have skipped over five eligible species and selected the sixth one as the type of *Lachnella*, knowing that it was already the type of another genus recognized by critical students as valid, is directly contrary to their own suggestion to follow current usage and is one of the mysteries in connection with their method or lack of method in selecting types which the writer has been unable to solve. Other illustrations are taken from the Hypocreales as follows:

5. The subgenus *Peckiella* was founded by Saccardo (*Syll. Fung.* **2**: 472. 1883) on *Sphaeria viridis* Albert. & Schw. and later raised to generic rank by Saccardo himself (*Syll. Fung.* **9**: 944. 1891). When a subgenus is raised to generic rank it is customary and logical to select the type of the subgenus as the type of the genus unless otherwise specified. At that time (1891) a number of additional species were added including *Peckiella xylophila*. According to custom the writer, in his monograph of North American Hypocreales, selected *Sphaeria viridis* as the type of the genus *Peckiella* which is distinguished from *Hypomyces* by its nonseptate spores. For more than twenty years this has stood as the type of the genus in North American literature (MYCOLOGIA **2**: 67. 1910; *North American Flora* **3**: 39. 1910). In spite of these facts, however, Clements and Shear select *Hypomyces xy-*

lophilus Peck as the type of the genus. This species was known only from the type locality in Ohio and the writer has in his possession material which is either type or cotype. As already indicated (MYCOLOGIA **2**: 73. 1910) this specimen is so fragmentary that it is difficult to determine its identity from spore characters. So far as we can judge, however, on its general appearance it is a poor specimen of *Hypomyces apiculatus* and not a *Peckiella* at all. Even if it were a *Peckiella*, to select a species which is practically unknown as the type of this genus in preference to the well known, widely distributed *Sphaeria viridis*, parasitic on species of *Russula* and *Lactaria*, on which the subgenus was based by Saccardo and already repeatedly designated as type of the genus is **not only illogical and illegal but not even consistent with their own suggestion:** "*the type species should be chosen from the best known or more important species generally included in the genus at present.*"

From the above it is apparent that types are selected "without rule or reason." And yet the authors state (page 15) that the International Commission "*recommends this method of fixing generic types.*" If so why have rules? Especially to be deplored is the utter disregard of the work of others. Many more cases might be cited but these will serve to show the utter lack of method and irresponsible manner in which types were selected.

MISLEADING CITATIONS

Another practice which should be severely criticized is incorrect citations of genera, *i.e. Otidea* and *Geopyxis* to Persoon; and *Acetabula*, *Dasyscypha*, *Humaria*, *Mollisia* and *Phialea* to Fries, who never used them as generic names, and such names as *Galactinia*, *Scutellinia* and *Sepultaria* to Cooke who used them as subgeneric names only. The above are only a few of the many illustrations that might be cited. Such practice is not only incorrect and illegal but leads to much confusion.

CHANGES IN SPELLING

While the authors of this work are (avowedly) opposed to any change in generic names, they are apparently not averse to changes in spelling of those names, *i.e.* provided those changes

are inaugurated by them. Clements and Shear (page 328) refuse to recognize the substitution of *Humarina*, by the writer, for *Humaria*, of Saccardo (1889), **which name had been previously used by Fuckel in an entirely different sense,** since this substitution would necessitate the addition of one letter "n" to the name and would therefore be a violation of the sacred law of "usage" which they claim to be following. These same authors, however, seem to have no pangs of conscience in changing the old, widely recognized names *Lycoperdon* of Linnaeus (1753) and *Hypoxylon* of Bulliard (1791) to *Lycoperdum* and *Hypoxylum* of Clements (1909) and for no reason except personal preference. Is the **recent, untenable, little-known** name *Humaria* any more sacred to mycologists from the standpoint of "usage" than the **old, perfectly tenable, widely-recognized** names *Lycoperdon* and *Hypoxylon?* Or does it make a difference who suggests the change? There are many other diversions from the original spelling, such as *Exoascus* to *Exascus; Gelatinosporium* to *Gelatinosporis.* (In the latter case, not only was the name mutilated but the wrong species was designated as the type and page citation incorrect.) Of course these changes are unjustifiable under the rules but what do these authors care for rules? Are they not a law unto themselves?

SYNONYMS

The attempt of Clements and Shear to work out the synonymy of the genera of the cup-fungi on a literary basis, *i.e.* without any knowledge of the plants themselves has resulted in some ridiculous combinations. One or two of these will be cited.

1. The genus *Catinella* Boud. is made a synonym of the genus *Aleurina* Sacc. (page 327). The former is an inoperculate species occurring on rotten wood and of a semi-xerophytic consistency, and with minute, smooth spores which at maturity are colored. The latter is a large fleshy cup-fungus occurring on the ground and with an operculate ascus, large reticulated, colored spores. The fact that one is operculate and the other inoperculate would of course have no weight with Clements and Shear, since they do not regard this character as having any taxonomic value. But, even leaving this character out of consideration, the two genera have absolutely nothing in common except that the spores

in both are colored and even this means nothing since *Catinella* has green spores and *Aleurina* brown. It is quite evident that the authors of this book had no first-hand knowledge of either genus.

2. Equally unwarranted is the reduction of the writer's genus *Pseudopithyella* to *Sarcoscypha*. If *Pseudopithyella* were to be reduced at all it should be made a synonym of *Humaria* as treated by Clements and Shear. It might be defined as a *Humaria* with a collared ascus just as *Streptotheca* is a *Rhyparobius* with a collared ascus. If the presence of a collar near the end of the ascus is a valid generic character in the one case it is equally valid in the other. Of course this reduction is again purely academic since evidently neither author had seen material.

3. It is again noted (page 329) that Clements and Shear have made *Melastiza* Boudier a synonym of their genus *Scutellinia* (*Patella* Weber). This species was founded by Boudier on the reticulate spored form, *Peziza miniata*. Just why this genus should have been reduced to synonymy is not apparent, since it was founded on a very good character, the same character in fact on which *Aleuria* was segregated from *Peziza*. Since the authors recognize the reticulate character of the spore as a valid one in the latter we fail to understand why they should disregard it in the case of *Melastiza*.

4. Another illustration is the reduction of the tropical genus *Cookeina* which is made a synonym of *Sarcoscypha* as treated by Clements and Shear (*Plectania* Fuckel as treated in North American Cup-fungi, 190. 1928). The genus *Cookeina* is made up of strictly tropical species characterized by their fasciculate hairs and striate spores, while the other genus *Sarcoscypha* (*Plectania*) is made up of strictly temperate species with non-striate spores and non-fasciculate hairs. While the two genera have a superficial resemblance in form and color I am sure that no one who had any critical knowledge of the species involved would treat them as synonyms. One or two other illustrations might be drawn from the treatment of the genera of the Hypocreales:

5. The genus *Nectriella* was founded by Nitschke and described by Fuckel (*Symb. Myc.*, 175. 1869). The genus was distinguished from *Hyponectria* by possessing 1-septate spores. Sac-

cardo later described the genus *Charonectria* (*Michelia* **2**: 72. 1880) based on exactly the same characters. In the monograph of the Hypocreales of North America (MYCOLOGIA **1**: 45. 1909 and *North American Flora* **3**: 4. 1910) *Nectriella* was regarded by the writer as the valid name while *Charonectria* Saccardo was treated as a synonym based on the rule of priority. Clements and Shear, however, again reverse the situation disregarding both priority and usage and make *Charonectria* the valid name while *Nectriella* Nitsch. is regarded as a synonym. This seems to be in keeping with their general rule to do something different from that which had been done by their predecessors, another contribution to the stabilizing of the nomenclature of the Hypocreales.

6. *Clintoniella* was founded by Saccardo (*Syll. Fung.* **2**: 532. 1883) on *Hypocrea apiculata* Cooke & Peck. After examining specimens of this species determined by Peck the writer became convinced that it was not a *Hypocrea* but a *Hypomyces*. The matter was taken up with Dr. Peck in 1907 and in reply to inquiries Dr. Peck states after examining type material of *Hypocrea apiculata* the following: "This is not a *Hypocrea* as reported but a *Hypomyces*. The generic distinctions then were not quite as clear as now." On the strength of this report *Clintoniella* which was based on this species was in the monograph of the North American Hypocreales made a synonym of *Hypomyces* and the type species described under that generic name. Clements and Shear, however, again reverse the decision and make *Clintoniella* a synonym of *Hypocrea*. This procedure is absolutely inexcusable inasmuch as all of these facts were published (MYCOLOGIA **2**: 74. 1910). Whether the authors of this work were guilty of gross negligence in failing to note these facts or otherwise the reader may judge for himself.

7. *Chromocrea* was founded by the writer (MYCOLOGIA **2**: 58) on *Hypocrea gelatinosa* and distinguished from *Hypocrea* by its colored spores. Clements and Shear make both this genus and one of the two genera, *Chromocreopsis*, mentioned below synonyms of *Pheocreopsis* Sacc. & Sydow. Possibly one of the genera might be a synonym of the above genus but since *Chromocrea* has a sixteen spored ascus and *Chromocreopsis* an eight spored

ascus they could not both be synonyms of the same genus, unless the authors choose to disregard the number of spores in the ascus as a generic distinction. If this attitude is taken, however, there is no reason for separating *Hypocrea* and *Hypomyces* since they are distinguished on exactly the same characters. To be sure the authors in their key describe the perithecia of *Hypomyces* as occurring on a subicle while the perithecia of *Hypocrea* occur on a stroma but would the authors please tell us what is the difference between a subicle and a stroma? If the presence or absence of a stroma is of no generic importance in separating *Nectria* and *Creonectria*, how can it be of any importance in separating *Hypocrea* and *Hypomyces?* That this distinction is not adhered by them is evident by the fact that *Hypomyces apiculatus* in which the perithecia occur on the subicle is placed in the genus *Hypocrea* which according to them is supposed to have a stroma although it does not rightfully belong there. Furthermore *Hypocrea sulphurea* (possibly the authors were not familiar with this species) has a subicle or stroma exactly like that of a *Hypomyces* so the only certain character left on which *Hypomyces* can be distinguished from *Hypocrea* is in the number and character of the spores. They cannot therefore consistently make *Chromocrea* and *Chromocreopsis* synonyms of the same genus if, indeed, either one of them is a synonym at all. This point cannot be determined definitely for lack of suitable material.

NOMENCLATURAL BUNGLES

Some of the anomalies in this volume can be explained only under the head of just plain bungles. One or two of these will be cited to illustrate the slipshod manner in which genera have been literally mangled.

A. TWO GENERA BY THE SAME NAME

1. On page 114 of this work the genus *Urnula* as represented by *Urnula Craterium*, the commonly known black "urn fungus," is placed in the family Dermateaceae and there stands out "like a sore thumb" as the only operculate genus in a family where all the other members are inoperculate. On page 138 another genus *Urnula* as represented by *Urnula terrestris* (which is the

type of *Podophacidium* Niessl) is placed in the family Pezizaceae. This is equally out of place since it is inoperculate and the family Pezizaceae is characterized by the presence of an operculum as stated by the authors themselves (page 12). Then (page 313) the *Urnula* (*Podophacidium*) as represented by *Urnula terrestris* is made a synonym of *Urnula* as represented by *Urnula Craterium*. Thus we have two genera by the same name *Urnula*, both cited to the same author (Fries), but each characterized by a different species (one operculate and the other inoperculate), each placed in a different family (the inoperculate in the operculate family and the operculate in the inoperculate family) and finally the two cited as synonyms of each other. Just how may I ask the authors can these things be? **How can two genera have the same name, and if they belong to different families how can they be synonyms the one of the other?**

2. Again, the genus *Chromocreopsis* was founded by the writer (MYCOLOGIA **2**: 63. 1910) and the type designated as *Chromocreopsis cubispora* Ellis & Holway. In 1915 the writer named a new species *Chromocreopsis striispora* for John A. Stevenson, then of Porto Rico, which was later published (*Jour. Dept. Agr.* **1**: 213. 1917). Clements and Shear in recording *Chromocreopsis* erroneously assign it to Stevenson in 1917 although he had nothing to do with the founding of the genus which was described by the writer seven years earlier. They then made *Chromocreopsis striispora* Stevens the type although this species was not even known when the genus was founded. *Chromocreopsis* is then made a synonym of *Sarcoxylum* Cooke (originally *Sarcoxylon*), a genus which was described by Cooke in 1883 but has not been in use as a valid genus since that time. So far as we can judge from the descriptions, the genera are in no sense synonymous and even if they were why on the basis of "usage" should these authors dig up a name which has never been used as a valid genus by Saccardo or Engler & Prantl to replace *Chromocreopsis* which has stood in North American literature for more than twenty years. **Is this consistent with their avowed purpose to disregard priority in favor of usage in order to avoid change?** To make matters worse the second genus by the same name assigned to the writer (Seaver) and typified by *Hypocrea cubi-*

spora was listed and then made a synonym of *Phaeocreopsis* Sacc. & Sydow. Thus we again have records of two genera by the same name *Chromocreopsis*, assigned to different authors, typified by different species, and each made a synonym of a different genus (see p. 280 and 283). There never was but one genus *Chromocreopsis* and that was described by the writer as indicated above. **How could one genus possibly be a synonym of two different genera?** Just why a genus *Chromocreopsis* should have been attributed to Stevenson who had nothing to do with the genus other than to publish a species previously named by the writer, it is difficult to understand. Perhaps the authors of this book may have some plausible explanation.

B. TWO GENERA WITH THE SAME TYPE

The authors (page 328) have treated *Detonia* of Saccardo as typified by *Peziza leiocarpa* Curr. as a synonym of *Lamprospora* following the work of the writer (*North American Cup-fungi*, 54. 1928) in this procedure. On the same page, however, they treat *Plicariella* Saccardo typified by the same species *Peziza leiocarpa* Curr. as a valid genus. Of course this is impossible. So far as the writer is aware Saccardo never used the name *Plicariella* except for a subgenus of *Phaeopezia* (*Bot. Centr.* **18**: 218). Lindau (*E. & P. Nat. Pfl.* 1^1: 179) made Saccardo's *Plicariella* a genus but treated *Detonia* as a synonym as has been done in North American Cup-fungi (54). Just why Clements and Shear should have separated the two but leave them typified by the same species it is difficult to explain. Apparently just another bungle.

C. INVALID NAMES

The genus *Durandia* was described by Rehm (*Ann. Myc.* 11: 166. 1913. Not *Durandia* Bockel. 1896) and based on specimen sent by Dr. E. J. Durand. A most casual survey of the literature would have revealed to the authors of this work the fact that the name was and is untenable, or this information might have been had for the asking since the writer had already proposed for his forthcoming monograph the name **Durandiella** nom. nov. to replace the untenable *Durandia* of Rehm and still keep the genus in honor of our late E. J. Durand.

The generic name *Haematomyces* is also untenable in the sense used by the authors as has been pointed out by Petch (*Ann. Bot.* **33**: 405. 1919) and by the writer (MYCOLOGIA **22**: 52. 1930). In March, 1930 the writer proposed and published the genus *Ascotremella* to replace the untenable *Haematomyces*. Since this name, *Ascotremella*, does not appear in their synonymy, we assume that it was an oversight or perhaps it was too recent. However, the fact that Honey's genus *Monilinia*, published in the same work (MYCOLOGIA **20**: 153. 1928) does not appear in their index leads the writer to suspect that possibly the authors do not have access to this publication.

The persistent use of invalid names by the authors of this work is apparently one of the privileges which is claimed on the ground of "usage" which seems to be merely another name for "anarchy" or total disregard for all nomenclatorial rules. Just how stability of nomenclature can ever be brought about by such a procedure, if indeed it can ever be brought about at all, it is difficult for the writer to comprehend. If mycologists cannot agree on a uniform system of rules how can they ever agree on usage? While the rigid enforcement of rules may bring about some temporary confusion the total disregard of such rules can result in nothing but permanent chaos, of which the present volume is a striking illustration.

CONCLUSION

Unfortunately the writer has not had time to make a critical study of all the genera of even his own groups as represented in this new work. The above are but a few of the many outstanding errors and irregularities detected in a very casual survey. If the treatment of the genera of the cup-fungi may be taken as a fair sample, this work could truthfully be characterized as the largest volume of misinformation, inconsistencies, and contradictions which the writer has ever encountered. Yet the authors state "*It is hoped that most of the types selected here will be found acceptable and generally adopted*," supposedly by the International Commission on Nomenclature. This would be equivalent to the establishment of a "dictatorship" in the field of taxonomic my-

cology. To even cherish such hope in the light of the above facts is absurd. It is regrettable that such a pretentious volume should have been sponsored by one who is not primarily a mycologist and who has so little critical knowledge of the fungi in general and apparently less knowledge of the mycological literature which has appeared in the last twenty years. As stated above these comments apply only to the groups in which the writer has done critical work. Each mycologist must judge for himself as to the merits of the work in his own particular field. —F. J. SEAVER.